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Semi-Diagnostic Test Materials For Aural Rehabilitation

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Charles Hutton

E. Thayer Curry

Mary Beth Armstrong

There has been considerable interest in multiple-choice word lists designed to measure auditory, visual and combined auditory-visual intelligibility. This report has to do with the development of such materials and some of their use. The construction of the materials arose from the need for a systematic method of analyzing the intelligibility errors of hard of hearing clients as a way of paralleling the 'phonetic analysis' commonly used in speech correction. The results of the error analysis would be used to form, in part, the basis of the therapy program. Retesting after therapy would show not only the amount but also the kinds of improvement.

Development of Test

Initial attempts to discover a rapid and convenient way to analyze error on lists of words like the PB tests were fruitless. The alternative seemed to be to limit the number of responses by providing a set of answers from which the subject could make his choice. Thus the general form of the present test is similar to the multiple-choice word intelligibility lists developed for military use (*6*). The first semi-diagnostic test form, prepared in 1956, consisted of 71 consonant discrimination items and 33 vowel discrimination items. Each item contained four words, for example, 'mash, mat, man, mass' from the consonant section, and 'at, eat, it, ought' from the vowel section. Four answers seemed to be a practical number. Three would mean a large percentage correct by chance, and it was frequently not possible to find five words. It is apparent that words for a set were chosen which differed from each other by only one phoneme. In the above sets the key words were 'mass' and 'eat,' respectively. If the subject missed these words, they were considered errors in the /s/ and /i/ phonemes. Thus it is seen that the correct answer involved not only a key word, but more properly a key phoneme. The distribution of these key phonemes in the key words was determined by a composite distribution of the phonetic occurrences

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TABLE 1. Approximate per cent of occurrence of 36 phonemes in speech and their distributions in two word lists.

Phoneme	*Composite Distribution*	*List 1*	*List 2*	*Total of Lists*
/t/	8.6	4	4	8
/n/	7.5	4	3	7
/ɪ/	6.9	4	3	7
/ə-ʌ/	6.4	3	3	6
/d/	4.8	3	3	6
/s/	4.6	2	3	5
/ɚ-ɝ/	4.2	2	2	4
/l/	4.1	2	2	4
/m/	3.2	1	2	3
/k/	3.1	2	1	3
/w-hw/	2.9	2	1	3
/ɛ/	2.7	1	2	3
/ð/	2.7	2	1	3
/a/	2.6	1	2	3
/æ/	2.5	1	1	2
/ɪ/	2.4	1	1	2
/aɪ/	2.3	1	1	2
/i/	2.3	1	0	1
/f/	2.1	1	1	2
/h/	2.0	1	1	2
/u/	2.0	1	1	2
/eɪ/	1.9	1	1	2
/r/	1.8	1	1	2
/ou/	1.8	1	1	2
/j/	1.7	1	1	2
/v/	1.7	1	1	2
/ɔ/	1.7	0	1	1
/p/	1.6	1	1	2
/b/	1.6	1	1	2
/ʊ/	1.4	1	0	1
/g/	1.3	0	1	1
/ŋ/	1.1	1	0	1
/ʃ/	0.8	0	1	1
/θ/	.7	0	1	1
/dʒ/	.3	1	0	1
/tʃ/	.3	0	1	1
Total	99.6	50	50	100

found by French, Carter and Koenig (5), Travis (14) and Voelker (15). This arbitrary composite distribution, which appears as the first column in Table 1, was also used in the two subsequent revisions to be discussed below. The individual distributions agree in general. Data on written materials were not included.

In the first form primary consideration was given to providing phonetic distribution and minimal contrast among the answers. Little consideration was given to word frequency since it was assumed that because the subject could see the words, the familiarity would be relatively unimportant. Lists in this form were administered to 25 aural rehabilitation clients over a two-year period. All lists were given with the subject's own aid during auditory only and combined auditory-visual testing. A one-way-vision mirror was used for measuring visual intelligibility. Individual senior and graduate clinicians tested the subjects assigned to them, using live voice in a conversational manner with approximately six feet between speaker and listener. Testing was supervised by one of the writers.

The results indicated that subjects varied considerably in their respective error distributions and indicated the kind and amount of improvement following therapy, thus confirming the utility of the procedure. It was also noted that some adults and most children did not choose many of the less familiar key words. No direct evidence is presented to support this observation because the difficulty of an item was also influenced by the amount of phonemic contrast within any one series as well as the relative difficulty of the key sound in the series. However, obvious difficulty with certain unfamiliar words involving key sounds which were easily identified in familiar words indicated that familiarity was having some influence on the error distributions, especially with certain clients. For this reason, in the next form (1958 revision) words were chosen which generally met the following criteria: A or AA occurrence in the Thorndike-Lorge general count (*13*) and also occurrence in the first 2000 words, grades 1-4, in Rinsland (*10*). A sec-

ond change in this revision involved cutting the number of items to 50 and presenting two words in a series in order to reduce administration time. This revision was used in a manner similar to the 1956 form for a year, after which each item was analyzed to find out how well it was discriminating for auditory and visual stimuli between good and poor listeners. Items not performing well were modified or replaced. The resultant form was designated as the 1959 revision. The phoneme distribution for this form appears in Table 1. Provision was also made at this time for a second word list which would complement the first list. Each list would contain 18 vowel and 32 consonant discrimination items, approximating the proportion of French, Carter and Koenig (*5*) when /ɚ/ and /ɝ/ are counted as vowels.

The key words selected for Semi-diagnostic Test 1A appear below:

1.	lad	an
2.	eyes	burn
3.	pie	tea
4.	cut	knee
5.	pain	like
6.	men	some
7.	wife	cat
8.	then	sit
9.	he	nut
10.	row	wing
11.	seek	change
12.	bowl	eat
13.	it	place
14.	same	with
15.	day	bear
16.	fur	cool
17.	seen	ten
18.	wood	did
19.	won	vote
20.	lies	far
21.	fill	wide
22.	night	lay
23.	will	luck
24.	yet	pool
25.	played	led

In the process of developing discriminating items for this test it was decided to use two words (*luck, pool*) which did not meet the above familiarity criteria in the Thorndike-Lorge general count and seven words (*knee, lad, led, pain, seek, vote, wide*) which did not meet the Rinsland criteria. All of these words met one criterion, and most of them were close to the other. Measurements to be discussed below seem to indicate that they are useful items. The 50 words were recorded by the senior author on a system consisting of an Altec-Lansing M-11 microphone and a Magnecord M-90 tape recorder set at 15 ips.[1] The words were uttered at a low level considered appropriate for conversation at six feet. No monitoring device was used. Allophones usually slighted in 'average' speech, *e.g.*, final stops, were not stressed. In this respect these stimuli seem to be more like the older PAL list recordings than the newer CID versions. Dubbings at 15 ips of the 50 words were cut and spliced into six different master recordings, along with 25 numbered carrier phrases, so that each item was of the form, 'Number one is . . . *lad* . . . *an*.' A five-second pause was inserted between items as an answer period. A set of eight presentation tapes, lists 1A and 1B being repeated at the end, were dubbed from the master tapes at 7½ ips through a Spencer-Kennedy Laboratories type 302 electronic filter set at 130 cps high pass. The purpose of rolling off the very low frequencies was to prevent overloading at high presentation levels.

A set of answer sheets, convenient for experimental and clinical use, was prepared for the six orders. The form

[1]Consideration was given to the possibility of a sound-film recording, but the idea was rejected on the basis of the lack of a convenient playback device for clinical use.

Client _____ Aud ____ Score $2(R-\frac{W}{3})$ ____%

Date _____ Vis ____ Wrong ____

Speaker _____Level___db Comb ____ Distance ____

Amp ____ Room ____

DRAW A LINE THROUGH THE WORD YOU HEAR

1.	led	an	9.	tea	net	17.	seen	pen	18.	wide	did	25.	plate	let
	laid	add		he	not		seem	ten		word	dead		play	led
	lad	at		key	night		sing	then		wood	dad		played	leg
	lied	am		see	nut		seed	hen		what	died		plane	less
2.	I'd	barn	10.	low	win				19.	gun	wrote			
	eyes	burn		row	will					fun	boat			
	ice	born		go	wing					run	note			
	I've	been		bow	wind					won	vote			
3.	pie	tea	11.	seen	chains				20.	wise	far			
	tie	see		seat	chair					rise	for			
	high	she		seek	chained					dies	fur			
	by	key		seed	change					lies	fair			
4.	caught	we	12.	bowl	ate				21.	full	lied			
	cat	me		boil	it					feel	wide			
	coat	knee		ball	at					fill	died			
	cut	be		bull	eat					fell	ride			
5.	pen	luck	13.	it	plate				22.	light	lay			
	pain	lake		if	plays					bite	way			
	pan	lack		is	place					might	ray			
	pine	like		ill	play					night	day			
6.	mean	sun	14.	shame	will				23.	will	lake			
	mine	such		came	wish					we'll	look			
	men	song		tame	with					well	luck			
	man	some		same	win					wool	lock			
7.	wife	can	15.	gay	bear				24.	let	pole			
	white	cap		day	pair					yet	pull			
	wipe	cat		bay	dare					met	pile			
	wise	catch		they	wear					get	pool			
8.	pen	set	16.	far	tool				25.	plate	let			
	then	sat		fire	cool					play	led			
	ten	seat		fur	fool					played	leg			
	when	sit		fair	pool					plane	less			

FIGURE 1. Answer sheet for Semi-Diagnostic Test 1A.

for SD1A appears as Figure 1. An attempt was made to select as many alternate answers as possible which met the above familiarity criteria and which offered little phonemic contrast. The other forms contained the same 200 words in various random orders. A group of 24 college students between the ages of 17 and 23 who exhibited normal hearing were selected as the first group of listeners. Normal hearing was defined as passing a 10-db ear-choice (*3*) sweep test from 250 cps through 8000 cps on a

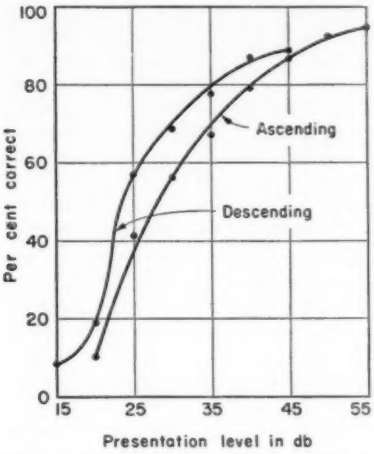

FIGURE 2. Ascending and descending intelligibility gain functions of auditory test SDI.

Beltone 10-A audiometer. The subjects were brought in in groups of four to participate in 30-minute listening sessions. The playback system consisted of an M-90 tape playback mechanism, a Hewlett-Packard 350B attenuator, a matching transformer, and four Permoflux PDR-10 headsets, the latter being located in a sound-treated room. The zero presentation level described by Fay (*4*) was used as a referent. Preliminary investigation indicated that a range of 20 to 55 db in steps of five db would sufficiently define an ascending curve. Listeners were instructed as follows:

> This is a multiple-choice word test. There are eight lists of words, each list containing 50 words. You will hear a number followed by two words. Draw a line through the words you hear. The first list will be very soft, the second a little louder, and so on. If you hear only a part of the word, make the best guess you can. If you hear nothing, leave the answer blank.

A second group of 10 subjects meeting the same criteria above were used to obtain data on a descending series. Instructions and presentation levels were appropriately modified.

The answer sheets were scored as follows: The number of right, wrong and no responses were tabulated for each word at each level. The number correct was computed[2] and this score was divided by the total, yielding a per cent correct for each word or each presentation level. The mean values at each level are presented as gain functions in Figure 2. As was expected, systematic differences between the curves were found, the slope of the ascending function being approximately 3.2 %/db in the middle 60 per cent of the curve. The effect of this gentle slope was to give a relatively high 50 per cent threshold of 27.9 db. The descending curve has a slope of approximately 3.9 %/db in the same range with a threshold of 24.1 db. The steeper gain function of the descending series was probably due to the learning of items during the higher presentation levels at the beginning of the run. This explanation is seemingly supported by the small percentage of no responses found in the middle part of the descending series as compared to the larger percentage found in the ascending run. The thresholds are not greatly different from the value reported by Hirsh, *et al.*, (*8*) for the W-22 recordings, but the slopes appear to be much closer to the old PB discs. In view of the use of a small familiar vocabulary and the restriction of choices in the procedure, the results suggested that these particular recorded stimuli may involve rather difficult discrimination tasks, and thus may better differentiate between

[2] Using the formula $S = R - \frac{W}{n-1}$ (*1*)

listeners than do the current W-22 recordings. While Hirsh, *et al.*, suggest that the differences between the old and new PB recordings can be accounted for on the basis of less variation in word level and restricted vocabulary on the W-22 tests, a direct comparison of the PAL and CID word lists by Siegenthaler (*12*) indicated that there were only small differences between the two lists of words. This suggests that the speaker variable has not received sufficient consideration in test construction, since it probably better accounts for the PAL list recordings and the SD1 recording having a mild slope characteristic.

In order to investigate the ability of the SD1 recording to differentiate between listeners and also to get an estimate of reliability, it was decided to present these stimuli to a group of hard of hearing subjects. However, before doing so, some modification of word levels as suggested by Harris (7) seemed to be in order. A gain function for each word was plotted and from this a 50 per cent threshold was estimated. As would be expected, the gain functions of the vowel items were found to be much steeper, resulting in lower thresholds. In some instances, especially among the more difficult consonant items, the level estimates were rather gross. The range of values was 29 db. Since the range of level of utterance on the original recording was only four db, this finding suggested that there was a wide range in item difficulty, indicating utility even with extreme clinical groups. Ideally, appropriate amounts of attenuation up to 29 db would be used to remove the effect of different 50 per cent levels on the slope of the gain function. Two factors, however, limited the amount of attenuation. One was the variation in background noise introduced by the process; the second was that with such large differences in level some words would cause severe overloading of a speaker or earphone at very high presentation levels. For these two reasons the maximum amount of attenuation was limited to seven db. Six new dubbings were made of the original word recordings, the number phrases, and three introductory sentences, all materials passing through two cascaded sections of SKL 302 filters set at 130 cps HP as before. After the six modified master recordings had been prepared, a 1000-cps tone was added for calibration purposes and a clinical presentation tape was dubbed at 7½ ips.

Clinical Procedure

A group of 30 subjects was selected as representative of the clinical range commonly encountered. Those with various types and shapes of audiograms and with congenital and adventitious pathologies were included in the sample. The age span of the group was eight to 71 years. Each subject was individually retested for pure frequency and speech thresholds on an Allison 20-A audiometer housed in a two-room testing suite. Following the measurement of thresholds, four recorded auditory tests, W-22 list 2E at 78 rpm (repeated) and SD1A and SD1B, were administered free field in alternate orders on the same equipment 30 db above the client's SRT. The 30 db free field level was selected because higher levels had previously proven to be uncomfortable for some subjects. In one instance the presentation level was limited by the maximum output level of the audiometer. Upon completion of the auditory testing, the subject was

TABLE 2. Pure frequency threshold and test-retest speech discrimination scores for 30 clients with different audiometric types of hearing loss.

Client	*AC**	*BC**	*W-22† List 2E*		*SD1†*		*Visual*		*Comb.††*		*SD1*			
											C_1	C_2	V_1	V_2
C1	18	7	96	94	89	92	29	22	95	97	3	3	1	0
C2	20	5	96	100	95	95	27	23	89	95	2	2	0	0
C3	25	–7	98	98	89	92	31	30	97	95	2	1	2	2
C4	25	8	96	94	89	97	10	10	97	97	3	1	1	0
C5	27	–8	98	100	97	100	31	47	95	100	1	0	0	0
C6	32	8	94	90	84	89	25	39	95	100	5	4	1	0
C7	37	8	100	100	97	100	35	22	97	100	1	0	0	0
C8c	42	–2	100	98	89	97	34	49	100	95	3	1	1	0
C9	42	3	94	96	97	92	0	13	97	97	1	2	0	1
C10c	48	3	88	96	89	95	48	40	89	89	3	2	1	0
Mean			96.0	96.6	91.5	94.9	27.3	29.5	95.1	96.5	2.4	1.6	.7	.3
M1	33	22	72	76	57	60	25	18	87	76	9	10	7	5
M2	40	10	92	92	95	97	22	26	95	97	2	1	0	0
M3c	40	17	96	96	63	60	17	15	87	87	6	9	8	6
M4c	43	12	96	94	52	57	0	0	76	81	10	9	8	7
M5	52	25	96	100	87	95	26	28	97	100	4	2	1	0
Mean			90.4	91.6	70.8	73.8	18.0	17.4	88.4	88.2	6.2	6.2	4.8	3.6
CN1	25	17	76	76	55	68	27	17	87	92	15	12	2	0
CN2	25	27	88	94	84	92	29	37	100	95	3	2	3	1
CN3	27	32	88	86	76	79	34	27	100	100	9	7	1	1
CN4	28	30	96	96	87	89	33	23	97	92	5	4	0	0
CN5	32	27	74	78	65	71	19	7	81	89	11	9	2	2
CN6	32	35	88	92	81	87	37	21	92	92	6	4	1	1
CN7	38	35	92	96	89	92	55	47	97	97	3	2	1	1
CN8	43	35	94	92	71	84	28	33	89	97	9	4	2	2
CN9	45	43+	86	88	79	87	32	35	89	87	5	4	3	1
CN10	48	37	92	92	76	84	51	54	95	92	8	4	2	2
CN11c	48	42	56	68	49	52	47	41	79	81	11	11	8	7
CN12	50	47+	70	82	65	68	55	44	92	92	11	8	2	4
CN13	55	48	66	66	31	34	32	32	77	81	18	13	9	12
CN14c	58	NR	72	80	72	73	57	60	92	89	9	8	2	2
CN15c	60	50+	46	62	36	39	27	33	81	76	20	16	4	7
Mean			78.9	83.2	67.7	73.3	37.5	34.1	89.9	90.1	9.5	7.2	2.8	2.9

*500–2000 cps average for the better ear.
†Freefield.
††Earphones.

taken to a suite of therapy rooms for presentation of visual and combined auditory-visual stimuli. The rooms were connected by a large double-pane window and auditory training system previously described (*9*). Four SD1 lists (C, D, E. F) were administered live voice in a manner approximating as closely as possible the recorded versions. The first two lists were presented via visual stimuli only and the next two via combined auditory-visual stimuli at a comfortable listening level. In all instances the procedures used in the auditory, visual and combined testing were those routinely employed for clinical purposes.

The subjects were assigned to one of three audiometric classifications in Table 2 on the basis of the air- and bone-conduction averages at 500, 1000 and 2000 cps. Subjects designated as 'primarily conductive' exhibit

less than an average 10-db loss by bone conduction; those having an average bone-conduction loss of 10 db or more and an average air-bone separation of 10 db or more were designated 'mixed' type hearing losses; the term 'primarily cochlear-eighth nerve' was used to indicate an air-bone separation of less than 10 db. In instances where one or more of the bone-conduction thresholds exceeded the output limits, a plus sign was added to the average. It is apparent that the conductive and mixed losses fell mainly in the mild and moderate categories, while the cochlear-eighth nerve losses spanned a range from mild to severe.

Results and Discussion

One of the basic questions about a discrimination test is its ability to differentiate among different types of hearing losses. Examination of the W-22 and SD1 measures for the conductive group indicates that the scores were quite high and the over-all SD1 mean of 93.2 per cent was only slightly smaller than the 96.3 per cent over-all W-22 mean. However, such was not the case for the mixed losses where the W-22 mean (91.0 per cent) remained moderately high while the SD1 mean (72.3 per cent) dropped sharply. Both sets of scores were down in the cochlear-eighth nerve group, but the SD1 scores were consistently lower. As a result of the greater differences between audiometric groups, the SD1 scores for the conductive and cochlear-eighth nerve groups had less overlap. Thus it appears that the SD1 test differentiated more effectively between types of hearing losses than did the W-22. The differences between these two tests were statistically significant at the one per cent level when the Wilcoxen rank-order test (*11*) was applied, but there appears to be no clinically important difference between the second set of W-22 and SD1 scores for the conductive group. Comparison of the first W-22 and SD1 scores with the second set of scores indicates that learning took place on both tests in all three audiometric groups. Examination of the last four columns in Table 2 shows that most of the learning occurred on consonant items.

In addition to the over-all score, a substantial amount of information was available from the error distributions on the SD1 which indicated, among other facts, that the consonant-vowel error ratio for the conductive losses was higher than the ratio for most of the mixed and cochlear-eighth nerve losses. The cochlear-eighth nerve subjects with mild losses with one exception have higher ratios than those with greater loss. Further, those with congenital mixed and cochlear-eighth nerve losses, designated by the 'c' following the client's number in Table 2, seemed to have lower error ratios than those with similar adventitious losses. While the size of these subsamples is so small that any such observations should be regarded as tentative, the data suggest that it may be possible to arrive at a series of diagnostic error profiles which would have application in both testing and therapy situations. Further indications along these lines can be seen by examining the visual and combined scores. All the visual scores were relatively low, but the mean scores of the cochlear-eighth nerve group were considerably higher than for the conductive group. Presumably the cochlear-eighth nerve group has been forced to learn visual clues to make up for its auditory deficiencies. This assumed learning would then account for the relatively high combined scores which compare favorably with the

TABLE 3. Measures of dispersion and reliability of auditory tests. N for W-22 and SD1 = 30.

Test	*Standard Deviation* (%)	*Reliability Coefficient*	*Error of Measurement* (%)	*95% Confidence Interval* (%)
PB 9B*	17.3	.80	7.8	15.3
PB 10B*	15.7	.83	6.8	13.3
W-22 2E	12.0	.95	2.7	5.3
SD1	17.9	.98	2.5	4.9
SD1 Visual	14.0	.81	6.1	12.0
SD1 Combined	6.9	.81	3.0	5.9

*Data from Bilger and Hirsh (*2*).

combined scores of the conductive group. The mixed group, whose SD1 scores spread over a wide range, had the lowest mean visual scores which may account for the fact that they had the lowest combined means. It is readily evident that the individual visual and combined scores frequently did not distinguish between subjects in the same way or to the same extent that the SD1 auditory scores did.

A test may be useful if it distinguishes between groups in various ways, but it will be more useful if it differentiates among individuals within as well as between groups. It can be seen from Table 2 that both the W-22 and the SD1 tests demonstrate the widely held clinical view that given adequate loudness the subject with a conductive pathology will have a high discrimination score, regardless of the amount of loss. Thus the range on both tests was relatively small. The range of scores for the mixed group was large on both tests, with the dispersion on the SD1 appearing to be substantially greater than that on the W-22. As would be expected, the most pronounced dispersion of scores was found in the cochlear-eighth nerve group. Again the SD1 appears to have the greater variance. The standard deviations for the total sample which are presented in Table 3 reflect the above observations and demonstrate the advantage of the SD1 in distinguishing between clients. The distributions of the SD1 and W-22 scores also differ in one other respect. The standard deviations of the test and retest scores for the SD1 were 17.93 per cent and 17.96 per cent, respectively, and 13.51 per cent and 10.53 per cent for the W-22, indicating that the SD1 retains its sensitivity in repeated presentations. Further study is needed, but this result has obvious implications for multiple testing as in hearing aid evaluations. Data from two of the older PAL PB recordings are included for comparative purposes, but it should be remembered that, as indicated above, the variance of any sample of scores will increase as the number of conductive losses in the sample decreases. In addition, the range of the mixed and cochlear-eighth nerve groups has some effect on the dispersion of scores.

Two other important considerations in individual testing, reliability and error of measurement, are also shown in Table 3. The reliability coefficients for auditory tests SD1 and W-22 were both quite high and the errors of measurement were considerably lower than those reported for the older PB tests. The limits of the intervals within which test-retest scores would be expected to fall 95 per cent of the time, if a correction

for learning is made, are substantially smaller for the SD1 and the W-22 than the intervals for the PB 9B and PB 10B records. Thus the SD1 appears to combine the sensitivity of the PAL recordings with the reliability of the W-22 test. It is interesting to note that the consonant items, which to a considerable extent are responsible for the wide dispersion of scores on the SD1, appeared to be less stable than the vowel items. Accordingly, it would seem that if the proportion of highly discriminating items were to be increased, the SD1 test would become less reliable. Further, most of the subjects who exhibited large test-retest differences on the SD1 did not exhibit such differences on the W-22 and vice-versa. The lower reliability of the visual scores may have partially resulted from the negative attitude of most clients toward this kind of testing. Even in instances where their auditory and visual scores were not greatly different, subjects seemed to look upon the auditory test as being much easier. However, the similar coefficient for the combined testing probably indicates that the reliability of the visual and combined intelligibility scores was limited by the live voice procedure involved. In this connection it should be emphasized that the person serving as the speaker must practice until he is able to produce relatively consistent utterances of the character of those on the SD1 recording. Even so, clinical observation suggests that scores from different speakers are not comparable, and that the live voice gain function is considerably steeper than the recorded gain function.

Summary

The development of a multiple-choice word list suitable for testing auditory, visual, and combined auditory-visual intelligibility in aural rehabilitation has been described. In the development of the list consideration was given to phonetic occurrence of the key sounds, ease of error analysis, word familiarity, phonetic contrast within the answer sets, and ability to discriminate between good and poor listeners. The resultant test in auditory form was presented to normal and hard of hearing listeners and compared with other auditory tests. It was found to be sensitive to different kinds of hearing loss and to yield reliable estimates of discrimination ability. Diagnostic implications of the auditory error analysis, as well as the live voice visual and combined test results, were briefly discussed. Because of the seeming utility of the auditory test, steps have been taken to make disc and tape recordings available to interested persons.[3] The reason for preparing both types of recordings is that while most speech audiometers are presently equipped only for disc playback, the convenience and durability of tape recordings suggest they will have wider use in the future.

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Preferred Method For Clinical Determination Of Pure-Tone Thresholds

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Confusion and disagreement exist as to the preferred method for clinical determination of pure-tone thresholds. The procedures described in the literature are contradictory and sometimes quite complicated (*1*, 7, *18*, 27). Moreover, as Hirsh emphasizes, 'Since there is still no accepted standard technique, the clinician must be warned that the differences among these techniques may be responsible for differences among the thresholds that result from their use' (*8*). Not only does this uncertainty distress the conscientious audiometrist, but he often feels uneasy because necessary simplifications of routine cause him to deviate from full adherence to recognized methods for psychophysical measurement.

The purpose of the present paper is to urge that clinicians standardize their practices by adopting the basic features of the Hughson-Westlake (*10*) technique. Both theoretical and practical considerations make this procedure logical for routine use when testing is done with a conventional pure-tone audiometer. This technique was accepted in 1944 by the Committee on Conservation of Hearing of the American Academy of Ophthalmology and Otolaryngology. In slightly revised form, it has since been advocated in various publications sponsored by the Committee (*19*, *20*). Clinicians who have used the method have found it to be straightforward and satisfactory.

The discussion which follows (1) gives a brief description of an improved version of the Hughson-Westlake technique, (2) reviews those features of auditory behavior which determine the suitability of this method and (3) reports an experimental comparison between this method and two other procedures.

Hughson-Westlake Method

The fundamental feature of the Hughson-Westlake procedure is that *minimum audibility is measured only by progressively increasing the stimulus intensity*. In other words, presentations always progress from levels where the sound is inaudible to the first level where preception of the stimulus occurs. As soon as the stimulus is heard, a new ascent is initiated.

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When using this procedure, *the clinical threshold is defined as the minimal level at which perception is achieved in more than half of the ascents.* In consequence, the Hughson-Westlake technique is sometimes called 'the ascending method.'

Obviously, the specific exploratory procedure just described cannot be undertaken until the subject has been appropriately prepared for it. Consequently, the total process of administering an audiometric test is more involved than the preceding paragraph implies. The important thing, from the clinician's standpoint, is to keep the preparatory phases clearly separate in his own thinking from the procedures of threshold exploration *per se*.

The first step in preparation is to assure that the subject is fully aware of the experience for which he is to listen. The audiometrist, therefore, begins by presenting to the subject a tone of sufficient intensity to evoke a clear and concise response. This tonal presentation, as is also true of all subsequent ones, should be one or two seconds in duration. A particularly easy way of evaluating the subject's response is to have him raise his finger whenever he hears the stimulus. The audiometrist must, of course, estimate the presentation level which is required and must be prepared to use more intense levels if a clear and concise response is not evoked at the outset. The only purpose here is to be certain that the subject understands fully the task expected of him.

It has proved practical, when testing by air conduction, to administer the first tonal presentation at a hearing level of 30 to 40 db if the subject appears to have approximately normal acuity, and at a hearing of 70 db if only a moderate impairment seems to be present. Provided these levels are inadequate, subsequent presentations are increased in steps of 15 db until the subject's response is positive. In any event, at least one definitive practice response should be elicited before proceeding to the next step in the procedure.

The second step is to decrease the tonal level until the stimulus is definitely inaudible. The only purpose here is to prepare for the first exploratory ascent. An efficient method for reaching the level of inaudibility is to drop the intensity of successive presentations in steps of 10 or 15 db. This sequence is carried through rapidly. A single response at one level is the cue to decrease to the next lower level. The advantage of such a sequence, in contrast to the process of dropping immediately to a hearing level of zero db or weaker, is that the subsequent ascent will usually be started closer to the level at which the threshold lies. The saving in time is important to the clinician.

Once the level of inaudibility has been reached, the exploration for threshold begins. This exploration is carried out with a series of short tonal presentations. So long as the subject does not respond, each presentation is made five decibels stronger than its predecessor. However, as soon as a response occurs, the level of the next stimulus is dropped 10 to 15 db and another ascent in five-decibel steps is begun. The clinician keeps track of the levels at which responses occur. He designates the intensity at which the majority of responses appear as the threshold level for the test tone. Experience has shown that a practical criterion is to accept three responses at a single intensity as the threshold. This criterion is often achieved in three or four ascents.

The clinician must remember always to present successive stimuli as discrete events separated by completely toneless intervals. Morever, each tonal burst should be not less than one second and not more than two seconds in duration. This requirement is easily achieved. The clinician merely adjusts the audiometer while the instrument is set so that no signal is being emitted. He then presses the 'tone-on' switch to produce the next stimulus presentation.

All other details of procedure, such as the choice of the ear to be tested and of the progression of frequencies to be employed, are flexible. Moreover, the revised Hughson-Westlake technique is applicable to both air-conduction and bone-conduction explorations. The only restrictions in the latter instances are those imposed by the reduced range of hearing levels which are testable through bone conduction.

In summary, the critical features of the revised Hughson-Westlake technique are (1) that only ascending series of tonal stimuli are used, (2) that successive stimuli are separated by toneless intervals and (3) that each ascending run is terminated as soon as the subject responds. The technique is easy to employ when the subject is properly indoctrinated. The question which remains to be answered is whether the Hughson-Westlake technique is defensible from the standpoint of audiological theory.

Adaptation and On-effect

It is a fundamental fact, as the statement quoted earlier from Hirsh implies, that an individual's auditory sensitivity can be modified substantially by the conditions of stimulus presentation. This fact imposes a responsibility on the clinician to select test conditions which encourage consistency in the subject's momentary acuity and which explore a precise boundary of sensitivity. In other words, since arbitrary decisions regarding procedure are unavoidable, it is the clinician's duty to choose reasonable stimulus conditions and to understand why he has chosen them.

Our knowledge of two auditory phenomena, on-effect and adaptation, makes it possible to state categorically that relatively brief tonal presentations must be used in conventional pure-tone audiometry. Such presentations enhance the reliability of the measured threshold. They also encourage response at the minimal intensity level to which the subject is ordinarily sensitive, thus giving an estimate of his best practical acuity. Stated conversely, continuous stimuli are clinically unacceptable because they induce variability in the intensity levels at which responses occur. This problem arises because prolonged stimuli produce temporary and progressive desensitization of the auditory system. Such desensitization becomes particularly pronounced with some kinds of hearing impairment.

To explain: the initial response of the auditory system at the onset of stimulation is its most vigorous response. This initial reaction is termed the on-effect. When the stimulus is sustained, the on-effect is followed by a reduction in responsiveness even though the stimulus is too weak to produce fatigue. This change is known as auditory adaptation.

On-effect and adaptation have been demonstrated through animal experimentation. Derbyshire and Davis (2) observed the two phenomena of on-effect and equilibration in the action potentials recorded from the eighth nerve of the cat. Galambos and Davis (4) found both rate-adaptation and

amplitude-adaptation in the impulse trains carried by second order neurons of the cat's auditory system, while Tasaki (*24*) noted gradual decrease in the frequency of impulses elicited in response to sustained tones within first-order nerve fibers of the guinea pig.

The features of on-effect and adaptation, as exhibited by both subjects with normal hearing and with auditory impairments, were discussed by Hood (*9*) when he reported his studies on perstimulatory fatigue. Normal adaptation has subsequently been explored extensively (*3, 11*). However, it was Hallpike and Hood (*5*) who highlighted the clinical implications of the two phenomena by their suggestion that 'on-effect normality' may be combined with susceptibility to extreme adaptation, called relapse. This combination, they claim, characterizes not only the adapted normal ear, but also the 'recruiting sense organ of Ménière's disease.' In both instances, there is an initial burst of auditory response at the onset of stimulation, provided, of course, that the threshold intensity is exceeded. This state is manifest to the listener as an initial maximal loudness. It is followed, if the stimulus is sustained, by a rapid deterioration in the response. This deterioration is the manifestation of relapse. Hallpike and Hood emphasize that recovery occurs quickly. The full on-effect may be elicited anew provided the listener is allowed a brief respite from stimulation.

The existence of individuals who undergo relapse and yet preserve the capacity for strong on-effect responses has been demonstrated repeatedly and in various ways (*12, 13, 14, 21*). One must now recognize that relapse at threshold is not restricted to cases with cochlear lesion, but that this phenomenon can at times be encountered with neural lesions. One must also recognize that details such as the speed of relapse, the rapidity of recovery, and the variation of effect with frequency differ from one case to another. The unescapable fact, from the standpoint of deciding on a routine for clinical audiometry, is that subjects are encountered whose momentary responsiveness is radically affected by exposure to sustained tones.

A critical point here is that both the normally adapted auditory system and the relapsed auditory system regain responsiveness after a brief resting period. Full recovery ordinarily occurs in a second or two. Consequently, the audiometrist may have confidence that he is exploring his subject's maximal acuity at each test frequency if every stimulus is preceded by a toneless interval of several seconds. Moreover, since the on-effect will be elicited at the outset of stimulation, there is no value in prolonging any tonal presentation more than a couple of seconds. When the audiometrist does prolong the tone, he merely initiates a process of normal adaptation or one of relapse, depending upon the case being tested.

The foregoing considerations lead to the conclusion that, provided one wishes to measure the subject's unadapted threshold (his on-effect responsiveness) by conventional audiometry,[1] each audiometric stimulus should be one or two seconds long and should follow a silent interval of at least three seconds. One is not justified in conducting a routine clinical

[1]Various techniques of pulse-tone audiometry are justifiable in terms of the considerations reviewed here. However, discussion of these techniques is beyond the scope of the present paper, which is concerned exclusively with an analysis of the traditional audiometric methodology.

test by presenting a clearly audible tone and then decreasing its intensity without interruption until the tone becomes inaudible. Such a procedure produces an unknown amount of adaptation. The amount depends upon the speed of stimulus transitions, upon the susceptibility of the subject to abnormal adaptation and, since higher intensities produce greater adaptation, upon the starting level of the sequence. The only thing one can be certain about is that such a procedure will usually give a pessimistic impression of the subject's acuity.

Evidence supporting this last statement was obtained by Miller and Rosenblith. These investigators, according to Hirsh (*9*), found that 'descending' thresholds obtained on normal hearers with continuous tones of 4000 cps required as much as 15 db more sound pressure than did the analogous 'ascending' thresholds. They also found that the magnitude of the discrepancy increased as the starting level of the descending sequence was raised. Only when the descending sequence was begun essentially at threshold was acuity as good with it as with the ascending progression. Furthermore, Rosenblith and Miller obtained better thresholds for both ascending and descending progressions when the 4000-cps stimulus was interrupted than either progression yielded when the stimulus was continuous. One would expect the differences to be more dramatic in cases where relapse operates.

The clinician must recognize one further characteristic of any procedure which uses discrete tonal presentations separated by substantial intervals of time. Such a test situation is not even analogous to one wherein a train of successive pulses is changing continuously in intensity. In the former case each tonal presentation is an event sufficiently isolated in time so that it is independent of its neighbors. The subject will respond if his momentary sensitivity in relation to the stimulus intensity is sufficient for the on-effect to be evoked. Since each event is independent, it is theoretically irrelevant whether the clinician has patterned the succession of stimuli in a descending, in an ascending, or in a combined sequence. One is not justified in thinking of this procedure as constituting a form of the method of limits simply because he decides to vary presentation levels progressively. Therefore, one need not feel any responsibility to combine sequences of ascending and descending 'crossings' of the threshold. Instead, the audiometrist may choose whichever sequence has the greatest practical advantage. Hence, it is legitimate to adopt the revised Hughson-Westlake technique. This method has the practical advantages of simplicity and of high economy in clinical effort.

Five-Decibel Step

The traditional concept of a threshold rests on the premise that the subject is continually undergoing fluctuations in sensitivity (*23*). According to this view, the subject's minimal response level at any given instant is determined by his status at that instant. Therefore, a series of measurements must be made in order to obtain a statistical estimate of his threshold, which is usually defined as the stimulus value at which there is a 50 per cent chance that he will perceive the stimulus. This estimate is derived from a finite series of measurements. The series is obtained according to one of the standard psychophysical methods.

A critical requirement, which ap-

plies to all psychophysical methods, is that it must be possible to present a reasonable array of stimulus values which actually lie within the subject's range of moment-to-moment variability. Stated conversely, if the steps between stimulus levels are too large, a precise estimate of the threshold will be impossible because information which contributes to the estimate is not obtainable at enough levels. Under such circumstances, some levels will be useless in threshold computation because they always evoke response, whereas others will be analogously useless because they never evoke response. The most extreme case, of course, is the situation where the size of the interval between successive stimulus levels is greater than the range of the subject's moment-to-moment variability. When this situation exists, all that can usually be determined is that response never occurs at one presentation level and always occurs at the next higher level. Here, even in those fortuitous instances where one stimulus level happens to probe the subject's moment-to-moment variability, the none-and-all pattern will characterize responses at the two flanking levels. Again, a precise estimate of threshold is impossible, and the investigator must still be satisfied with designating one presentation level at which responses seldom or never occur and a second level, immediately higher, at which responses usually occur. Such information may be highly useful, but it is not threshold determination according to the traditional premises of psychophysical exploration.

There exists substantial evidence, some of which is reviewed below, that moment-to-moment fluctuations in auditory sensitivity are often encompassed within a range which is less than the five-decibel step used in conventional audiometry. Since such is the case, the audiometrist should recognize that he cannot define an individual's threshold in precise statistical fashion so long as he varies stimulus intensity in five-decibel steps. Hence, the audiometrist need not feel impelled to structure his testing technique according to one of the classical methods of psychophysics, and he need not feel guilty if he does not do so. Instead, the clinician should choose his audiometric technique to take advantage of the high consistency of response which may be expected from most subjects during single tests when the five-decibel step is used. He should adopt a procedure which quickly gives the dichotomous information to which the five-decibel step restricts him.

Several studies supply evidence supporting the premise that the moment-to-moment variability of the individual is not large in relation to the five-decibel step of conventional audiometry. These studies help one answer the question, 'What is the moment-to-moment stability in the auditory sensitivity in the ordinary listener?'

Ward (*25*, *26*), while developing his technique of 'single descent' group audiometry, obtained two kinds of information which are pertinent. For one thing, Ward tested 12 enlisted men repeatedly at both 500 and 4000 cps. The stimulus was a continuously changing train of pulses. Ward combined two pulse rates (1.5 and 2.25 pps) with two attenuation speeds (1.5 and 3.0 db). Each of the four resulting conditions were presented five times to every subject. Subjects were instructed to report 'just when the beats disappeared.' Ward found his four parameters of stimulus descent to be essentially equivalent in reliability as gauged by the standard devia-

tion of repeat judgments. Moreover, he comments, '. . . the standard deviation of repeat judgments (earphones not moved) is 1.7 db . . .' (*26*).

Secondly, Ward used his 2.25 pps and 3 db/sec. parameter of descent to study the test-retest consistency exhibited at 2000 and 8000 cps by 1200 naval personnel. He remarks, 'The median difference, disregarding sign, is 2.4 db for both 2000 and 8000 cps. This implies that the median SD of repeat judgments is 1.7 db' (*25*). It is also evident from Ward's data that almost 50 per cent of the test-retest discrepancies were less than 2.5 db and about 80 per cent were smaller than five db.

One may interpret Ward's findings as indirect evidence that the short-term physiological fluctuations in the auditory acuity of ordinary listeners (as exemplified by Ward's subjects) are generally of the same order of magnitude as the five-decibel step employed in clinical audiometry. If this had not been the case, test-retest differences would have emerged as much larger in Ward's study—since physiological fluctuations constitute only one of several factors contributing to the variability he observed.

Of course, since Ward used only descending series of pulses, one wonders whether the consistency he found in repeat judgment was thereby spuriously improved. In one sense it is irrelevant to raise this question, because any method which induces consistency in human response demonstrates the reliability which it is possible to achieve if one structures the test situation properly. In another sense, however, the question is highly pertinent when one is inquiring into the moment-to-moment fluctuations of human listeners. Hence, the findings of other workers are *apropos*.

Wertheimer (*28*) investigated the stability of the threshold for 80-msec. clicks by the method of constant stimuli. Three subjects were used. Wertheimer found '. . . that the average sigma of measurement of the auditory threshold within one session was .69 db . . . .' This value is astonishingly small, and it indicates short term stability in auditory acuity which is much better than clinicians usually assume. Interestingly, Wertheimer found that the average sigma of 10 thresholds obtained within a single day was only .87 db, while the sigma of thresholds obtained daily over a period of 23 successive days was only 1.22 db. Hence, he demonstrated that consistency of auditory acuity can persist over relatively long periods of time.

Munson and Wiener (*15*) investigated the differences between successive thresholds at 1000 and 6000 cps as obtained by the 'ABX' method. They reason, 'Within the framework of the limited tests reported here, it can be concluded that the variance σ^2 of the threshold determinations . . . is about 1.5 $(db)^2$ if a good method is used for measuring the stimulus. This variance is believed to be primarily a measure of the variability of the observers' sensory system.' Harris and Myers (*6*) add the comment that each threshold obtained by Munson and Wiener was roughly an average of the status of sensitivity over a five-minute interval. Even as such, the Munson - Wiener findings bespeak greater stability of auditory sensitivity than many would expect.

The investigation conducted by Myers and Harris (*17*) on the inherent stability of auditory thresholds is a most provocative exploration of short-term fluctuations in auditory sensitivity. Myers and Harris measured the auditory acuity of three young men at each of 11 frequencies.

The procedure used was the serial method of limits. Five descents and five ascents were employed at each test frequency. Stimuli were presented at five-sec. intervals. Every stimulus was a .75-sec. pulse of the test tone. Successive pulses differed in intensity by one db. A point of 'threshold crossing' was computed independently for each descent and for each ascent. The exploration was conducted not only by air conduction but, in duplicate, by bone conduction. Myers and Harris summarize their basic finding as follows, 'The typical short-term threshold fluctuation was of the order of less than a decibel. This is the total fluctuation as the result of instability in the subject's attending and responding systems as well as in his auditory system proper.'

The minimum standard deviation exhibited by a single subject for a single frequency is .34 db and the maximum is 1.68 db. Considering individual subjects and each frequency separately, the standard deviation is under one db in exactly half of the instances. Moreover, Myers and Harris (*17*) conclude that, 'There is no difference in threshold fluctuation between air and bone conduction or among frequencies.' They also state, 'Inexperienced subjects are not troubled with the "zone of detectability," a region within which an experienced subject is uncertain whether the stimulus is an indefinite noise or is actually a pure tone.'

Two further points are important:

1. Myers and Harris (*17*) report, 'There is a tendency for a descending series to yield a somewhat better threshold than an ascending series.' They add, however, 'No completely reliable difference (between the two sequences) exists at any frequency for any subject . . . At most . . . (the difference) . . . amounts to little more than one decibel . . .' Actually, the average superiority of the descending thresholds over the ascending thresholds is .16 db when computed for all subjects at all frequencies by both air and bone conduction. Obviously, from the practical point of view, .16 db is an infinitesimal difference which is completely negligible. Hence, the Myers and Harris data support the expectation, which derives from recognition of on-effect, that a single tone of short duration is a sufficiently discrete entity that the listener's response to each presentation is essentially independent of the sequence in which it is placed.

2. Myers and Harris (*16*) found, 'Four crossings of the threshold (two ascending and two descending) are a sufficient number to produce a reliable threshold.' Actually, in only five comparisons out of 66 does the threshold as estimated from the first four crossings differ by a decibel or more from the threshold as estimated from all 10 crossings. Furthermore, the mean difference for all 66 comparisons is .35 db. Such results are encouraging to the clinician because they add to the assurance with which he can accept a threshold based on a few trials, provided, of course, he employs a method which has the requisite inherent reliability.

All the foregoing findings give one confidence in the validity of the Hughson-Westlake technique as a method for assessing the maximal acuity of clinical subjects. The moment-to-moment variability which typifies the normal hearing subject is sufficiently small so that the five-decibel step employed in conventional audiometry is too large to allow effective exploration of this variability. In other words, when the five-decibel step is used, any technique which ex-

cites on-effect may be expected to yield essentially equivalent findings for subjects with normal hearing. All that one can do under such circumstances is to ascertain the five-decibel step which separates the minimum hearing level at which responses always or usually occur from the maximum level at which responses are evoked only occasionally or not at all. Moreover, one is restricted to the same kind of information when testing cases with conductive impairments, since these people possess normal sensori-neural systems and hence will exhibit moment-to-moment variability similar to that of persons without hearing impairment.

The situation is less certain when dealing with sensori-neural losses. Many such cases, particularly those whose involvements have stabilized, probably also undergo restricted fluctuations in acuity. True, this expectation awaits experimental test. The important point, for the moment, is that the Hughson-Westlake method is justified even in instances where this expectation is not realized. To explain: when testing patients who undergo abnormal moment-to-moment variability in acuity, it is particularly important to use a technique which evokes on-effect, because many, if not all, of these patients will be prone to relapse. Testing such patients with sustained stimuli will increase their variabilities by evoking responses while they are in various stages of relapse. Exploration with short-duration tones will counteract this difficulty by eliciting on-effect. Such exploration has the further advantage of yielding estimates of unadapted acuity. These estimates are more valid criteria of each subject's capacity to react to transient sounds, like speech, than are measures of their sensitivities while relapsed. Therefore, the Hughson-Westlake method is appropriate even when testing subjects whose transient fluctuations in acuity are abnormally large. The method's simplicity recommends it over other procedures which evoke on-effects but which embody more complicated exploratory sequences.

Experimental Comparison

Theoretically, the Hughson-Westlake method will yield thresholds which are equivalent to those obtained with other clinical techniques that also excite on-effect responses. This premise required experimental scrutiny. Therefore, the investigation reported below was undertaken. Its purpose was to evaluate the extent to which different sequences of stimulus presentation affect the level that is designated as threshold. Specifically, thresholds were obtained by the ascending method of Hughson-Westlake, by an analogous descending sequence of isolated tones, and by a combined ascending-descending sequence.

All testing was done with a commercial audiometer (ADC-50-E) which activated a PDR-1 earphone mounted in an MX41/AR cushion. An auxiliary 20-db pad was inserted between the audiometer and the earphone to provide the range of low intensities required to test normal hearing subjects, some of whom could be expected to exhibit hyperacute auditory sensitivity.

The acoustic output of the audiometer was measured daily by means of a 6-cc coupler (ASA Type 1), a calibrated condenser microphone (Western Electric, 640 AA), a cathode follower (ADC, D5153) and a vacuum-tube voltmeter (Hewlett-Packard, Model 400A). The pure-tone thresholds obtained during the study could consequently be reported in

terms of the sound pressure level developed in the ASA Type 1 coupler.

The clinical room employed was one constructed for psychoacoustic research. The ambient noise level in the room was 30 db, as measured on the C scale of a sound level meter (General Radio, Type 759).

The subjects used in the study were 36 students at Northwestern University. Their ages ranged from 18 to 24 years. Half were males and the other half females. Each was required to exhibit normal hearing as evidenced by the ability to pass an audiometric screen at a hearing level of 10 db re the USPHS norm. This screening test was administered at the octave frequencies from 125 through 8000 cps. In addition, only subjects whose history indicated freedom from ear pathology and from excessive noise exposure were accepted.

Each subject was seen for a single experimental session, during which thresholds at 250, 1000 and 4000 cps were established by each of the three clinical methods under investigation. The order of presentation of these three frequencies was counter-balanced with the three testing methods through the use of a Graeco-Latin Square design. One ear per subject was tested and the earphone was not moved once the test sequence had begun.

The following instructions were read to each subject at the outset of the experimental session:

> The purpose of this test is to see how well you can hear some faint tones. Each tone will be quite short. Some will be easy to hear. Others will be very faint. Whenever you hear one of these tones, no matter how faint it is, raise your finger. As soon as the tone goes off, lower your finger.

The experimenter assured himself that these instructions were understood and then the threshold testing was begun.

The three methods of threshold determination were designed to be as parallel as possible except for the progression of intensity changes:

1. The ascending method was the Hughson-Westlake procedure. Specifically, the following sequence was employed. The pure-tone stimulus was first presented 30 db above the subject's presumed threshold. The purpose was to obtain a positive and decisive response. Attenuation was next introduced in 10-decibel steps until the subject failed to react. Only one stimulus per level was presented. Both during this downward progression and in subsequent ascents, each stimulus was a tonal pulse lasting between one and two seconds. After the subject failed to respond, the first ascent was initiated. Successive increments were in five-decibel steps. The first ascent was stopped as soon as the subject reacted to a stimulus. The signal was next attenuated 10 to 15 db, and a new ascent was begun at this latter level. Ascending trials were continued until the subject had responded three times at one level. It was not required that these three responses be consecutive. The level eliciting these three reactions was recorded as the threshold.

2. The descending method was patterned analogously. Again, the exploration was initiated by presenting the pure-tone stimulus 30 db above the subject's presumed threshold. Again, too, all stimuli were tonal pulses of a second or two, and only one stimulus was presented per audiometric level. Here, however, the second step was to descend in five-decibel intervals until the subject failed to respond. The level was then increased 10 to 15 db and a new descent was initiated.

TABLE 1. Means and standard deviations of threshold sound pressure levels* yielded by 36 normal hearing subjects under three measurement techniques.

Technique	*250 cps*		*1000 cps*		*4000 cps*	
	Mean	*S.D.*	*Mean*	*S.D.*	*Mean*	*S.D.*
Ascending	24.7	4.0	9.3	4.6	16.8	7.2
Descending	24.1	4.3	7.8	4.8	15.5	8.4
Ascending–Descending	25.1	4.0	9.5	4.0	16.4	7.5

*db re: .0002 microbar in ASA Type 1 Coupler.

This process was repeated until three failures to respond were obtained at a single audiometric level. The next higher hearing level, *i.e.*, the last level at which response was noted in these three instances, was designated as the threshold.

3. The third method combined descending and ascending progressions. After an initial presentation at approximately 30 db above the subject's threshold, a descent like those just described was performed. The lowest intensity at which response persisted was recorded. Next, an additional attenuation of 10 to 15 db was introduced and then an ascent such as used in the Hughson-Westlake method was initiated. The level at which reaction first appeared was recorded. The hearing level was increased 10 or 15 db and a second descent was conducted, following which a second ascent was, in turn, completed. After a third descent and a third ascent, the average for the six measures of minimum audible levels was computed as representing threshold.

Table 1 summarizes the results obtained when the foregoing methods were administered to the 36 university students. The table reports both mean thresholds and standard deviations for the group. One notes that the mean threshold for the descending method is slightly better at every frequency than for either of the other two methods. Its maximum superiority occurred at 1000 cps where the mean threshold for the combined method was 1.7 db higher. The means of descending thresholds were .6, 1.5 and 1.3 db better than the means of ascending thresholds at 250, 1000 and 4000 cps, respectively. Interestingly enough, the combined method yielded poorer mean thresholds than did the ascending method at 250 and 1000 cps.

The superiority of the descending method over the other two methods might be argued from the results reported in Table 1. However, the magnitude of the mean advantage achieved by the descending thresholds over the ascending thresholds falls far short of the 10 to 15 db differential which clinicians often assume to exist. Moreover, the present results fail to confirm the commonly held hypothesis that a combination of ascending and descending series will yield threshold values intermediate between those which either type of run will yield if employed alone. Thus, as one contemplates the present results, he is impressed by the fact that the mean thresholds obtained here by the three methods are indistinguishable, from the practical point of view.

Further confidence in the general equivalence of the three methods is found in the standard deviations reported in Table 1. Considering each test frequency separately, the three standard deviations were highly similar. Thus, one concludes that the

TABLE 2. Distribution of differences in clinical thresholds yielded by 36 normal hearing subjects when tested by ascending and by descending sequences.

Ascending Minus Descending	*Test Frequency*			*Total*	
	250	*1000*	*4000*	*N*	*%*
-5	3	0	2	5	4.6
0	25	26	23	74	68.5
5	8	9	11	28	25.9
10	0	1	0	1	.9
Total	36	36	36	108	

TABLE 3. Distribution of differences in clinical thresholds yielded by 36 normal hearing subjects when tested by ascending and by combined ascending-descending* sequences.

Ascending Minus Combined	*Test Frequency*			*Total*	
	250	*1000*	*4000*	*N*	*%*
-5	5	2	2	9	8.3
0	24	31	28	83	76.9
5	7	3	6	16	14.8
Total	36	36	36	108	

*Nearest 5-db step designated as clinical threshold for combined sequences, with better level selected when the mean of six runs was equi-distant between two audiometric levels.

TABLE 4. Distribution of differences in clinical thresholds yielded by 36 normal hearing subjects when tested by descending and by combined ascending-descending* sequences.

Descending Minus Combined	*Test Frequency*			*Total*	
	250	*1000*	*4000*	*N*	*%*
-5	6	10	10	26	24.2
0	27	26	21	74	68.4
5	3	0	5	8	7.4
Total	36	36	36	108	

*Nearest 5-db step designated as clinical threshold for combined sequences, with better level selected when the mean of six runs was equidistant between two audiometric levels.

variability among subjects remained the same from one method to another.

The data at hand may be summarized in another way. One may ask how closely each subject agreed with himself when tested by the three methods. Such a comparison gives a particularly provocative picture of the findings because it highlights the practical equivalence which the three test methods exhibit.

The procedure for making the comparison was simple. All thresholds first had to be designated on a five-decibel scale. The original data from both ascending and descending techniques were already aligned in five-decibel intervals. It was therefore only necessary to assign each original threshold for the combined sequence to the closest five-decibel step on the audiometric scale. When the original measure was equidistant between steps, the better hearing level was selected. In other words, the data for the combined method were recast in the form that would logically be used in recording routine findings on an audiogram.

Differences among thresholds ob-

tained by the three test procedures were then compared for each subject separately. Tables 2, 3, and 4 summarize the tabulations of these differences. One notes that within each table the distribution of differences is sufficiently similar for the three test frequencies so that only the totals of differences for all frequencies need be discussed in comparing methods. There is *no* difference between the individual thresholds in 74 (68.5 per cent) out of the 108 comparisons involving the ascending and descending methods. In all but one of the remaining comparisons the difference in threshold is a single audiometric step (five db). The agreement is even better between ascending and combined methods. Here, 83 subjects (76.9 per cent) yielded identical thresholds; all of the 25 differences (23.1 per cent) were discrepancies of only five db. Finally, the parallelism between descending and combined methods was almost identical to the parallelism between descending and ascending procedures. Again, 74 (68.5 per cent) of the comparisons represented complete equivalence. All of the remaining 34 comparisons yielded a discrepancy of one audiometric step. Thus, Tables 2, 3 and 4 may be summarized by the statement that in approximately seven out of every 10 comparisons, audiometric results were identical when designated in a conventional clinical manner, and (with only one exception in the 318 comparisons) the remainder yielded differences of only one interval on the recording scale.

Two further factual items have some interest: (1) Identical thresholds for a single subject were obtained by all three methods in 62 (57.4 per cent) out of a possible 108 instances. Thus, more than half the time there was absolutely no deviation of one method from the other two. (2) In 45 of the 46 remaining instances, two of the three thresholds were the same. Here the distribution was as follows: the descending and the ascending thresholds were alike 12 times, the descending and the combined 13 times, while the ascending and the combined thresholds were equal 20 times. Thus, if one were using the results for the combined method as a criterion, he would observe that the ascending thresholds agree with this criterion better than do the descending ones. However, since there is really no way in the present instance of selecting a particular threshold as the more valid in each specific incident of discrepancy, one must reach the conclusion that the three methods under study emerge as clinically indistinguishable when the five-decibel step is the unit of testing and of threshold recording. Therefore, the choice among methods may rest on practical considerations rather than theoretical imperatives.

Discussion

The failure of the present study to demonstrate clinically important differences between procedures is merely evidence that the five-decibel step employed in routine pure-tone audiometry is too large to yield measurements which distinguish the subtleties of the listener's auditory variability. This outcome is to be expected when one remembers the nature of the on-effect and the small range of momentary fluctuations in auditory sensitivity which normal hearers undergo.

The clinician must be clear on the implications of these facts. He must distinguish between the reliability of reaction he may expect from an individual subject during a single audiometric test and the day-to-day consistency he may assume for re-tests

performed in the clinical situation. The reliability of the former can be very good, as the foregoing discussion has demonstrated, while the repeatability of measurement from one clinical examination to the next can be relatively poor. The latter fact has been amply demonstrated in many studies, ranging from the investigation by Hughson and Witting (*29*) to the one by Roach and Carhart (*22*). These studies supply the clinician with information on the precision with which he may accept any particular test as illustrative of the audiometric level which characterizes the patient's everyday hearing. These studies do not tell the clinician anything about the precision of measurement within a single test. In other words, such factors as difference in adjusting the earphones, other changes in the test situation, and true shifts in the hearing of the patient are responsible for the discrepancies which appear from one day's test to another. The clinician must make allowances for the unreliability which such factors produce, but he must not make the mistake of presuming that comparable variability is inherent in the patient's acuity from one moment to the next.

The alert clinician will bear in mind Hirsh's comment, 'The sources of . . . threshold variability are numerous and are not necessarily related to the variability of the observer's physiological threshold' (*8*). He will choose a technique for testing which is parsimonious of his own effort, which is simple for the subject and which gives an estimate of the observer's physiological threshold that satisfies clinical requirements for intra-test reliability.

The Hughson-Westlake technique meets these three criteria. Clinicians who have used it found it to be highly satisfactory because of the rapidity with which a skilled tester can obtain threshold and because of the easy task it imposes on the subject. Moreover, as demonstrated above, the Hughson-Westlake technique is equivalent, within reasonable clinical margin, to other techniques which also excite on-effect and which also employ the five-decibel step of traditional pure-tone audiometry. The procedure has the added merit of having been recommended for many years to audiometrists by the Committe on Conservation of Hearing of the American Academy of Ophthalmology and Otolaryngology. Therefore, the Hughson-Westlake method can quite properly be adopted by clinicians throughout the world as the preferred technique for determining thresholds for pure tones when using the conventional audiometer.

One thing must be remembered by the reader as he contemplates the recommendation, which is here renewed, that he use the Hughson-Westlake method. Every clinician has habituated a procedure which is now so comfortable for him that he finds it hard to believe another method could be as good. Despite his feelings of comfortableness with it, his technique has theoretical and practical limitations if it does not elicit on-effect. However, if he uses a technique which does elicit on-effect, his method is as good in seeking out the unadapted physiological threshold as is the Hughson-Westlake technique. Under such circumstances, choice between methods cannot be resolved by the criteria of simplicity and of parsimony. For one thing, habituation regarding these matters influences belief. In addition, there are other methods, such as the analogous descending exploration, which are equally fast and precise. The only way of choosing

between clinical procedures which are fundamentally equivalent in seeking out the unadapted threshold is to make an arbitrary selection. In the writers' opinion, the reason favoring arbitrary selection of the Hughson-Westlake technique is found in the long-term sponsorship which has been given to the method by the Committee on Conservation of Hearing. This sponsorship should encourage clinicians to adopt the method for the purpose of achieving widespread uniformity of routine audiometric procedures. Obviously, there will continue to be specific instances in which other audiometric methods are preferable, but audiology will achieve new maturity if clinicians employ these other techniques as conscious variations from a standardized practice.

Summary

The Hughson-Westlake ascending method for establishing pure-tone auditory threshold is recommended for general clinical use when audiometry is performed with a five-decibel intensity interval. The procedure, which presents stimuli for a second or two so as to elicit on-effect responses from the subject, encourages stability of reactions and yields measurement of the unadapted level of acuity. According to the theory of on-effect, the Hughson-Westlake method should yield thresholds which are clinically equivalent to those obtained by similar short tonal presentations patterned in descending or 'threshold crossing' sequences. Experimental exploration with 36 normal hearing subjects confirmed this expectation. Adoption of the Hughson-Westlake method is recommended over the other methods which also elicit on-effect for the purpose of gaining uniformity of procedure throughout the field of clinical audiometry.

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Importance Of Individual Hearing Aids And Early Therapy For Preschool Children

Adam J. Sortini

The majority of educators who work with hearing handicapped pre-school children are in agreement concerning the importance of early diagnosis and the fitting of individual hearing aids. There are educators, however, who continue to express doubt as to the practicability of fitting individuals in this age group. It was the purpose of this study to compare the effectiveness of early therapy and the application of individual hearing aids to a group of preschool subjects with a school-age group.

For the present study, with the cooperation of parents and several schools for the deaf in Massachusetts, individual hearing aids were prescribed for 25 school-age children ranging from 6.0 to 12.0 years of age. These children had never worn an individual hearing aid, had average losses ranging from 62 to 95 db in the critical speech range of 500 through 2000 cps in the better ear, and none was felt to have central hearing impairment. The mean decibel loss for the 25 subjects was 82.4. The mean age was 9.6 years, and examination of the school records of the subjects indicated that they were of at least average intelligence.

The second half of this study involved prescribing individual hearing aids for 60 preschool children. This group ranged in age from six months to 3.0 years, with a mean age of 2.1 years, and all lived in the New England area. The preschool group had losses ranging from 57 to 92 db throughout the critical speech range in the better ear and a mean decibel loss of 79.2. Diagnostic evaluation showed no evidence of central hearing impairment. Each subject was found to have at least average intelligence by tests conducted by a clinical psychologist.

Procedure

The present study was conducted over a three-year period from the time each group was fitted with individual hearing aids and includes a two-year follow-up after the study's completion. With the school age group, perodic visits were made by the subjects involved to the Children's Medical Center for counseling and audiological evaluation. Periodic visits were also made to the schools for the deaf to discuss the individual subjects with the school principals and teachers. Through the cooperation of the principals and teachers at the schools for the deaf, individual progress reports were made available periodically for each subject in the study.

With the preschool group, periodic counseling and audiological evaluations were conducted at the Children's Medical Center. Visits were also made, when feasible, to the home or nursery school situations throughout New

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TABLE 1. Hours per day during a three-year period hearing aids were used by 60 preschool and 25 school age children.

	School Age Group			*Preschool Group*		
	*EWH**	*Part Time*	*None*	*EWH*	*Part Time*	*None*
1953	1	18	6	44	14	2
1954	4	9	12	48	9	3
1955	4	5	16	52	5	3

*Every waking hour.

England where the children were enrolled. Reports were made available periodically by the nursery school teachers and teachers of the deaf at the nursery schools where the hearing handicapped children were enrolled, as well as by the parents themselves. At six-month intervals parents were sent questionnaires requesting the following information: (1) name of child, (2) specific date the aid was first fitted, (3) exact age at the time the aid was fitted, (4) how many hours the hearing aid was worn each day by the end of the first month, and each successive month through the end of the first year, (5) by the end of the second year, (6) the third year and (7) damage done to the hearing aid over the reported period.

The parents were asked to comment on: (1) what problems were encountered in having the child wear the hearing aid over the first year (or succeeding years), (2) how these problems were handled, (3) whether the behavior and personality of the child changed over the first six months, (4) over the first year and subsequent years, (5) if so, in what way?

Parents were also asked in each questionnaire what was happening to the child's speech in terms of: (1) the child becoming more aware of sound, (2) increased babbling, (3) words being picked up more quickly or at all, (4) words beginning to be connected, (5) whether or not people outside the immediate family circle were able to see progress in language development in the child, as well as behavior changes.

Discussion

Of the 60 preschool children involved in the study, 34 were wearing their hearing aids every waking hour by the end of the first month, and 40 of the 60 were wearing their aids every waking hour by the end of three months. Table 1 indicates 44 children were wearing their hearing aids every waking hour by the end of the first year in the preschool group as compared to 52 children having accepted their hearing aids every waking hour by the end of the third year. Among the problems encountered in the preschool group were pulling the mold out of the ear and chewing on the mold. The first problem was dealt with effectively in almost all cases by having the child for several days wear the harness and amplifier (beneath the clothing), minus the receiver and receiver cord. The mother was instructed to buy a standard-type woman's hair net and to sew pieces of cloth slightly longer than the area of the child's ear into the net. Pieces of ribbon were sewn at the bottom and tied under the chin to make the net stay in place. Within seven to 10 days of 'feeling' the mold

in his ear, but not being able to pull it out, the child accepted the mold—and complete hearing aid—and the net was discontinued.

For the great majority of preschool children, flexible ear molds were recommended for obvious reasons. In those subjects where the mold was chewed, a standard-type hard plastic mold was substituted temporarily, and the chewing of the mold stopped.

A number of objections have been raised in the past to the fitting of young children with hearing aids because it was felt that the amount of breakage would be excessive with this age group. Of the 60 children, two subjects damaged two hearing aids beyond repair and were wearing the third hearing aid by the end of the first year, and eight additional subjects were on their second hearing aid by the end of the first year. Eighty per cent had not damaged the hearing aid in any way by the end of the first year. By the end of the second year, one child damaged his hearing aid beyond repair at play, and another lost his hearing aid. For the third year, three hearing aids were damaged beyond repair at play. It is felt that the number of casualties for a group this size and age was not large enough to warrant consideration of the element of breakage as a serious problem.

Another problem reported by a number of parents was that relatives or friends objected to the child wearing the aid and caused considerable distress by making comments about it. The parents attempted to answer these statements by pointing out that the child had made little or no effort

TABLE 2. Hearing aid use by each of 25 school age children during a three-year period.

Subject	*Age When Fitted*	*db Loss*	*Hours Aid Worn Per Day*			*Benefit According to Classroom Teacher*
			End of First Year (1954)	*End of Second Year (1955)*	*End of Third Year (1956)*	
1	10	90	3–5	EWH*	EWH	No
2	10	82	3–5	EWH	EWH	Yes
3	7	82	EWH	EWH	EWH	Yes
4	12	80	1–2	none	none	
5	12	92	1–2	none	none	
6	11	87	1–2	1–2	none	
7	6	70	1–3	1–3	5–7	Yes
8	11	90	1–3	none	none	
9	11	90	1–3	none	none	
10	10	84	1–3	1–3	none	
11	7	75	3–5	3–5	3–5	Yes
12	11	95	1–3	none	none	
13	9	92	1–3	none	none	
14	7	84	1–3	3–5	3–5	No
15	12	86	none	none	none	
16	10	86	none	none	none	
17	12	62	5–7	EWH	EWH	Yes
18	6	80	5–7	5–7	5–7	Yes
19	7	90	none	none	none	
20	9	84	none	none	none	
21	7	82	5–7	1–3	none	
22	11	80	1–3	1–3	1–3	No
23	10	87	none	none	none	
24	9	77	5–7	1–3	none	
25	12	90	none	none	none	

*Every waking hour.

to speak up to this time and that the hearing aid would not harm him.

It was also noted in the questionnaires that a major factor in the parents accepting the problem (as well as the friends and relatives) was the behavior and personality change over the first several months to a year of a sufficient degree in many cases to be observed not only by the family circle, but by individuals outside the family circle. It was mentioned that the number of temper tantrums and crying spells decreased and that the child seemed happier as well as more aware of people in the immediate environment. Also, many children were less afraid of strangers and much more willing to accept them than before being fitted with the hearing aid. The most frequent comment made regarding the parents' reaction to the speech development of many children was that after being put on amplification the children vocalized more, with increased vocal play, babbling and awareness of sound in the immediate environment. It was noted that in many instances efforts were made to mouth what was being said to him, indicating increasing awareness of the speaker's mouth as a source of sound. This development was followed by actual attempts to verbalize, with parents reporting consistently that vowel sounds were always attempted first.

The last item in the questionnaire resulted in many parents reporting that individuals outside the immediate family circle who had not seen the child for several months were able to see and report significantly favorable changes not only in vocalization, but in personality and behavior as well. This would suggest that the behavior, personality and language development has improved significantly because of the child having been on amplification every waking hour.

Table 2 shows the results obtained with the school-age group. Although the 10-year-old child with a 90-db loss (Subject 1) was wearing his hearing aid every waking hour by the end of the second year, the classroom teacher felt (at that time—and even now) that no benefit has been derived from the hearing aid and it is worn for psychological reasons alone. The classroom teacher for Subject 14 felt he did not benefit from the hearing aid in any way and wondered whether or not this particular child wore the hearing aid willingly because his mother also wore a hearing aid. For Subject 22, the classroom teacher felt the child did not benefit from the use of the individual hearing aid at all and that the aid was worn one to three hours a day after class for psychological benefit only.

Tables 1 and 2 indicate that by the end of the first year, one subject in the school age group was wearing the hearing aid every waking hour, 18 part of the time (*i.e.*, from one to seven hours), and six had stopped wearing their aids completely. By the end of the second year, four were wearing their aids every waking hour, nine part of the time, and 12 none of the time. By the end of the third year, four children were wearing their aids every waking hour, five part of the time, and 16 had stopped completely.

Between 1956 and 1958, of the nine children wearing the hearing aids part of the time to every waking hour, none of the nine had stopped wearing them. Concerning the school children who refused to wear the individual hearing aids at all, the main reason given by the subjects themselves in most instances, as well as by the classroom teachers involved, was that they did not benefit from the individual hearing aid's amplification to the degree that there was any significant dif-

TABLE 3. Hearing aid use by each of 60 preschool children during a three-year period.

Subject	*Age When Fitted*	*db Loss*	*Hours Aid Worn Per Day* End of First Year (1954)	End of Second Year (1955)	End of Third Year (1956)	*Present Status* (1958)	*Present Age*
1	2.11	85	3–5	EWH*	EWH	S.D.†	7.11
2	2.8	75	EWH	EWH	EWH	S.D.	7.8
3	2.4	74	EWH	EWH	EWH	S.D.	7.4
4	2.3	77	EWH	EWH	EWH	S.D.	7.3
5	3	70	EWH	EWH	EWH	S.D.	8.0
6	2.6	65	EWH	EWH	EWH	P.S.††	7.6
7	2	90	1–3	EWH	EWH	S.D.	7.0
8	2.11	75	EWH	EWH	EWH	P.S.	7.11
9	1.3	87	EWH	EWH	EWH	S.D.	6.3
10	1.9	92	EWH	EWH	EWH	S.D.	6.9
11	3	75	EWH	EWH	EWH	S.D.	8.0
12	3	75	EWH	EWH	EWH	S.D.	8.0
13	1.5	85	EWH	EWH	EWH	P.S.	6.5
14	3	72	EWH	EWH	EWH	S.D.	8.0
15	1.1	90	EWH	EWH	EWH	S.D.	6.1
16	.6	60	EWH	EWH	EWH	P.S.	5.6
17	1.3	75	EWH	EWH	EWH	S.D.	6.3
18	3	90	none	none	none	S.D.	8.0
19	2.1	82	EWH	EWH	EWH	S.D.	7.1
20	1.11	87	EWH	EWH	EWH	S.D.	6.11
21	3	75	1–3	3–5	3–5	S.D.	8.0
22	.9	57	EWH	EWH	EWH	P.S.	5.9
23	1.9	82	EWH	EWH	EWH	S.D.	6.9
24	2.11	67	EWH	EWH	EWH	S.D.	7.11
25	1.9	80	EWH	EWH	EWH	S.D.	6 9
26	2.6	85	5–7	EWH	EWH	S.D.	7.6
27	2.9	87	5–7	5–7	EWH	S.D.	7.9
28	3	75	EWH	EWH	EWH	S.D.	8.0
29	1.8	90	EWH	EWH	EWH	S.D.	6.8
30	.7	57	EWH	EWH	EWH	P.S.	5.7
31	1.11	85	EWH	EWH	EWH	S.D.	6.11
32	2	57	EWH	EWH	EWH	P.S.	7.0
33	1.10	85	EWH	EWH	EWH	S.D.	6.10
34	2.2	75	EWH	EWH	EWH	S.D.	7.2
35	2.5	90	1–3	1-3	5–7	S.D.	7.5
36	2.1	75	EWH	EWH	EWH	S.D.	7.1
37	2.11	89	1–3	3–5	3–5	S.D.	7.11
38	1	60	EWH	EWH	EWH	P.S.	6.0
39	1	90	EWH	EWH	EWH	S.D.	6.0
40	2.6	74	EWH	EWH	EWH	P.S.	7.6
41	1.7	85	EWH	EWH	EWH	P.S.	6.7
42	1.9	87	3–5	5–7	5	S.D.	6.9
43	2.1	92	5–7	none	none	S.D.	7.1
44	1.3	87	EWH	EWH	EWH	S.D.	6.3
45	2.8	77	3–5	3–5	EWH	S.D.	7.8
46	2.6	74	EWH	EWH	EWH	S.D.	7.6
47	1.1	90	1–3	3–5	EWH	S.D.	6.1
48	2.3	75	EWH	EWH	EWH	S.D.	7.3
49	2.5	82	EWH	EWH	EWH	S.D.	7.5
50	2.1	85	EWH	EWH	EWH	S.D.	7.1
51	3	70	EWH	EWH	EWH	P.S.	8.0
52	3	75	5–7	EWH	EWH	S.D.	8.0
53	1.6	90	3–5	3-5	3–5	S.D.	6.6
54	2.9	82	1–3	5–7	EWH	S.D.	7.9
55	1.1	75	EWH	EWH	EWH	S.D.	6.1
56	2.2	87	EWH	EWH	EWH	S.D.	7.2
57	1	75	EWH	EWH	EWH	S.D.	6.0
58	1.3	85	EWH	EWH	EWH	S.D.	6.3
59	2.4	90	none	none	none	S.D.	7.4
60	1.10	70	EWH	EWH	EWH	S.D.	6.10

*Every waking hour. †School for Deaf. ††Public School.

TABLE 4. Age, hearing loss, speech reception threshold and grade of 11 children placed in public schools.

Subject	*Age When Fitted*	*db Loss*	*Aided SRT*	*Present Age*	*School Placement (Grade)*
1	3	70	30	8.0	Second
2	1.7	85	45–50(gross)*	6.7	First
3	2.6	74	30–35(gross)	7.6	Second
4	1	60	20	6.0	First
5	2	57	18	7.0	Second
6	.7	57	15	5.7	First
7	.9	57	17	5.9	First
8	.6	60	25	5.6	First
9	1.5	85	40–45(gross)	6.5	First
10	2.11	75	35–40(gross)	7.11	Second
11	2.6	65	27	7.6	Second

*By gross SRT (speech reception threshold) is meant the level in decibels to which the child gave indication of hearing sound. White noise, recorded music and live voice were used.

ference in their social adequacy or in classroom progress. In 11 out of 16 cases, the subjects indicated that what was heard through the hearing aid was totally unsatisfactory, that only 'noise' was heard and that the hearing aids were of no benefit. Although it is difficult to suggest any reason as responsible for not accepting the hearing aid, one might speculate whether or not this group when first fitted with the aid was old enough to expect to actually 'hear' with the hearing aid. Thus, when they realized that only limited benefit was possible, they had no desire or patience to utilize what they did 'hear' to benefit their total social adequacy.

Table 3 lists the preschool children fitted with hearing aids. By the end of the first year, 44 subjects were wearing aids every waking hour, 14 subjects were wearing aids part of the time, and two had stopped wearing them completely. By the end of the second year, 48 subjects were wearing their aids every waking hour, nine part of the time, and three had stopped wearing their aids completely. By the end of the third year, 52 subjects were wearing their aids every waking hour, five part of the time, and three not at all. According to the parents and teachers involved (as well as overt signs from the children), every one of the 57 children wearing hearing aids at the end of the three-year period was believed to benefit from the amplification provided by the hearing aid. The children themselves indicated that they were receiving benefit from the amplification, and in some instances refused to be dressed in the morning until the hearing aid was put on their person. Some children refused to take the hearing aid off when they went to bed at night, so that the mother was able to remove the hearing aid only after the child was asleep. In other instances, many two-year-olds would go to the parents as soon as the batteries were dead, or something was wrong with the aid, and indicate by signs that the aid was not working. In many cases, as soon as the hearing aid was turned 'on,' the child would vocalize to indicate to himself that he was 'on the air.'

Of the 60 preschool subjects used for this study, Table 4 shows that 11 are now in public school. It should be emphasized that none of the children was accepted for public school until

TABLE 5. Vowel sounds, in per cent, correctly used by children at five years.

Sound	*Hearing Handicapped Children (Present Study)*	*Normal Hearing Children (Wellman Study) (1)*
[i]	98.6	98
[ɪ]	75.9	76.5
[e]	90.3	92.3
[ɛ]	86.7	87.3
[æ]	89.8	91.0
[ɑ]	88.2	89.2
[u]	95.1	98.2
[ʊ]	87.9	88.4
[o]	95.7	96.9
[ɔ]	92.6	93.1
[ʌ]	100.0	100.0
[ə]	87.8	89.1

the applicants were screened by public school personnel and they, together with the Children's Medical Center personnel and others involved in the 'team' effort, felt that the child was potentially able to do public school work satisfactorily. Of the 57 children who were wearing the hearing aids in 1956, one child, (Subject 42) is not now wearing his hearing aid at all. One may also observe in Table 4 that Subjects 4, 5, 6, 7 and 8 had losses of 60 db or less. These five subjects had bilateral atresia of the auditory canals and were fitted with bone-conduction, oscillator-type hearing aids. Of the 11 children placed in public schools, four had profound losses ranging from 74 to 85 db, and no one knows how they will progress, except that up to now they have done satisfactory work. It should also be pointed out that for each of the 11 subjects now in public school, auditory training and/or speech reading as well as speech therapy are provided regularly by the school system. The availability of specialized instruction is obviously a major consideration in attempting to make decisions regarding educational placement of hearing handicapped children. If it is not possible to arrange for regular specialized instruction, one would justifiably question how a seriously handicapped child could make the grade alone. It is hoped that in the not too distant future there will be provisions for qualified teachers of the deaf to function as itinerant teachers in public school systems. Such provisions would enable certain children with serious hearing losses to have the benefit of regular specialized instruction; and at the required school age, public school might be at least considered.

Table 5 indicates that the number of vowels, in per cent, correctly used by hearing handicapped children, favorably compares with the norms as presented by Wellman (*1*) for normal hearing children. The procedure to obtain the results in Table 5 was to present the child with a card con-

TABLE 6. Consonant sounds, in per cent, correctly used by children at five years.

Sound (Initially Only)	*Hearing Handicapped Children (Present Study)*	*Normal Hearing Children (Wellman Study) (1)*
[p]	97.0	97.1
[b]	96.8	96.6
[t]	94.6	98.5
[d]	92.7	98.6
[k]	91.8	98.5
[g]	89.2	94.2
[m]	98.8	100.0
[n]	94.6	98.6
[ŋ]	43.7	50.7
[w]	85.7	87.1
[f]	92.8	100.0
[v]	79.2	84.0
[θ]	71.7	75.7
[ð]	72.9	79.4
[s]	74.0	77.1
[z]	80.9	86.7
[ʃ]	84.2	88.4
[ʒ]	81.9	88.9
[tʃ]	80.9	88.4
[dʒ]	82.7	89.7
[l]	88.8	91.3
[r]	85.6	88.4
[j]	90.1	95.6
[h]	95.3	98.5

taining a picture which displayed the test item. The child was asked to name the picture, and whether or not the sound was correctly produced was then recorded. The same procedure was used with consonants, as demonstrated in Table 6, although it should be noted that because of attention span, it was felt a sampling of test items presented in the initial position only would give a fair representative over-all picture. As would be expected, the over-all comparison of the two groups for consonant production did not yield as favorable scores as those for vowels, although it is felt that few hearing handicapped children with the losses in this study not receiving early therapy and the benefits of early amplification would be able to make some of the more difficult sounds at all, let alone make the less difficult sounds as well, and as often.

Summary and Conclusions

The results of this study indicate the definite benefit to be derived from early diagnosis, early therapy and use of amplification every waking hour in the hearing handicapped preschool child. With a favorable home environment and average or above average intelligence, a decision for school placement at the time the child has reached the required age, should not depend on decibel loss alone. Rather, the needs of the individual child should be considered before a final decision is made by the team involved which *has worked* with the child and which *will be working* with the child.

It is obvious that one may not assume that the mythical 'average child' with a profound hearing loss will be able to go to public school. On the other hand, with new techniques for early diagnosis and the remarkable advances in the design and performance of individual hearing aids, it is felt that the hearing loss in and of itself should not be the governing factor in school placement at the necessary age. For the great majority of preschool children who are unable to progress satisfactorily so that public school placement is possible, the results of this study suggest that language development, behavior and personality will benefit significantly from early amplification and therapy. One other benefit which should not be overlooked in fitting preschool children with a hearing aid is that through early diagnosis, most parents are able to become aware of, and accept, the problem at an early stage of the child's emotional and language development. Thus, the sets and attitudes of the parents will be helped considerably by knowing that their child is making progress. It is felt that these more favorable sets and attitudes will then be reflected in the parents' handling of the children.

The results of this study suggest that in order to obtain maximum benefit from amplification, the hearing handicapped preschool child of normal intelligence should be fitted with an individual hearing aid as soon as possible after the diagnosis is made. Furthermore, it would also appear that through being on amplification every waking hour and being provided with therapy, if possible, not only the language development of the child will be benefited significantly, but the behavior and personality as well.

Reference

1. Wellman, B. C., Case, I. M., Mengert, I. G., and Bradbury, D. E., Speech sounds of young children. *Univ. of Iowa Studies*, 5, 1931, No. 2.

A Longitudinal Study Of Speech And Language Development Of Brain Damaged Retarded Children

Bernard B. Schlanger

The brain damaged retarded child invariably exhibits communication difficulties. Speech emergence is delayed not only by the injured central nervous system but also by defects in the social and psychological areas. The organic symptomatology is often obscured and accompanied by behavior disturbance and a range of atypical behavior is encountered. While the organic factor is operative in delaying speech and language development, one observes social and cultural influences strongly affecting this behavior.

Looking upon mental retardation as a symptom complex and as a dynamic rather than a static condition, it can be hypothesized that the mentally retarded child is capable of improved behavioral functioning, including communication, within his genetic and physiological limits. It is felt that the deviant communication behavior found in these children could be ameliorated even though the cerebral defect is irreversible. Longitudinal investigations of individual cases by many disciplines over a period of years, not weeks or months, are needed for investigating fully the retarded child with aphasoid characteristics. From these studies one might determine how to break through the child's sound barriers and determine whether these barriers to language are erected by external or internal forces, or both.

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Subjects

For this study 12 children who were residents of the Training School at Vineland, New Jersey, were selected. These children were all severely delayed in speech and language development. Medical diagnoses indicated that brain damage was the primary cause of retardation. No gross motor crippling defects nor dysarthria were present.

Table 1 presents the C.A. and M.A. of each child at his latest evaluation, the estimated time of the onset of brain damage and the personality evaluations arrived at over a period of several years by staff psychologists. Chronological ages at the start of the investigation ranged from 4.8 years to 9.8 years, with a mean of seven years. At the final evaluation C.A.'s were from 8.2 years to 13.8 years with a mean of 10.9 years. The M.A. range was 2.8 years to 5.5 years with a mean M.A. of four years. At this time Stanford Binet I.Q.'s were from 24 to 53 with a mean of 37. I.Q.'s in many instances had dropped during the three

TABLE 1. Subject data on 12 brain damaged retarded children.

Subject	*C.A.*	*M.A.*	*Etiology*	*Personality*
1	10.1	4.0	Congenital cerebral maldevelopment	Poor but positive adjustment, dominant, extrovert
2	11.0	4.7	Congenital cerebral maldevelopment	Poor adjustment, distractive, hyperactive
3	11.1	2.8	Congenital cerebral maldevelopment	Poor adjustment, distractive, hyperactive
4	11.2	4.0	Congenital cerebral maldevelopment	Poor adjustment, distractive, hyperactive
5	13.8	3.3	Congenital cerebral maldevelopment and postnatal trauma	Poor but positive adjustment, dominant, extrovert
6	8.8	2.9	Cerebral birth trauma	Poor adjustment, distractive, hyperactive
7	10.5	3.4	Cerebral birth trauma	Poor adjustment, distractive, hyperactive
8	11.5	3.2	Cerebral birth trauma	Schizophrenia, autism
9	11.7	5.5	Cerebral birth trauma and postnatal trauma	Poor but positive adjustment, dominant, extrovert
10	8.2	4.3	Cerebral infection, postnatal	Poor adjustment, distractive, hyperactive
11	8.9	3.5	Cerebral infection, postnatal	Generally poor adjustment
12	11.7	4.6	Cerebral infection, postnatal	Poor adjustment, submissive, distractive

to four years the children were being observed. This would be anticipated since language forms so large a part of many of the intelligence tests.

Procedures

At the entrance of a child to the Training School, he receives speech and hearing evaluations as part of his diagnosis. Initial impressions of the child's communication and other abilities are rechecked during a three-month observation and diagnostic period (*4*). Because of the severely delayed speech and the obscured potential for communication, the children in this study were selected for therapy at their admission to the institution with continuing diagnosis as the rationale. The children were re-evaluated at least once a year by the entire professional staff and twice yearly by the rehabilitation and education personnel who were in frequent contact with the child. Speech therapy continued with varying degrees of intensity during the investigatory period and included at least one individual and one group session per week.

The initial phases of therapy concentrated on developing positive attitudes toward oral expressive and receptive language (*3*). Satisfying experiences were structured to attain an improved awareness, recognition and adjustment to sound and then to speech. Listening training was stressed and rewards, while not abundant, were frequently given, until the goal of therapy to the children may at times have appeared to be the 'treat.' When greater responsiveness to sounds and speech was observed accompanied by a parallel lengthening of the attention span, multi-sensory activities were employed in the attempt to develop a greater verbal output, a more fully developed sentence, more intelligible word production and an improved communication interaction. The ultimate goal was the development of the child's oral communi-

cation skills within the framework of his potential.

Measurements were taken at three periods of therapy. The first consisted of results from the initial examinations at entrance. The next re-evaluation results, designated as *Period A*, were taken 18-24 months after therapy began (*2*). The last judgments, *Period B*, occurred from 36-42 months after therapy was started. The variation in times within each period was due to the start of therapy occurring at different intervals for each child.

These measurements consisted of four judgments, all made by the examiner.[1] They consisted of:

1. *Repeated Isolated Words.* Seventy-one words of a developmental articulation test (*1*) were presented by the E. and repeated by the S's. The percentage of correct responses was obtained by dividing the consonant sounds repeated correctly in all the usual positions by the number of consonant sounds used in this developmental articulation test. An arbitrary division line was drawn at each quartile.

2. *Intelligibility of Spontaneous Speech.* This was broadly rated 'non-intelligible,' 'partly intelligible' and 'intelligible' and was based on oral responses to objects, pictures and conversation. As none of the children was 'readily intelligible,' this evaluation was not used.

3. *Maximum Sentence Length in Words.* The maximum number of words used in a sentence constituted the score whether in conversation, in response to objects or to pictures.

[1]Since the children were always available and seen frequently at play and in their classes as well as in therapy, it was felt that the E. had sufficient opportunities to validate his own clinical judgment. In addition, because of the variability in a pathological group such as this, as well as the small number of subjects, this investigation can merely summarize clinical experiences.

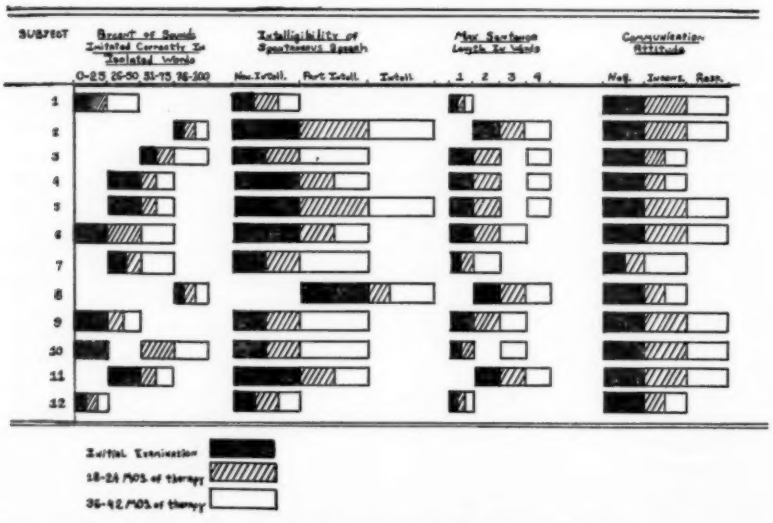

FIGURE 1. Therapy progress report on 12 retarded brain damaged subjects.

4. *Communication Attitude.* Communication behavior as observed in therapy and outside of therapy was judged as 'negative,' 'inconsistent' or 'responsive.'

Results

Figure 1 indicates the results of the initial examinations, and *A Period* and the *B Period.*

Initial Examinations. Speech and hearing evaluations given at admission indicated that the speech and language development of the majority of the children were at levels corresponding to those of children nine to 18 months old. Five of the 12 children used occasional vowel-like grunts or a single sound as their total output. Of the remaining children five others were able to produce a variety of sounds, but these were undifferentiated and unintelligible for the most part; two were able to produce many of the sounds, but one child, Number 2, was not intelligible in spontaneous speech; the other, Number 8, was only partially intelligible in spontaneous speech and was primarily echolalic. Nine of the children used one-word sentences, three were able to combine two words.

Simple oral directions were comprehended by all and responses indicating 'yes' or 'no' could be obtained either through an oral symbol or gesture.[2] However, apathy could best describe their attitude toward communication. There was little apparent awareness of speech or even a desire to speak. Verbal contact was difficult to establish in all cases. Inattention and at times hostile resistance were typical reactions to all efforts to stimulate speech.

A Period. Slight advances were demonstrated in articulation by six of the children as indicated by a higher percentage of words correctly imitated and in an increased intelligibility of spontaneous speech. The first measure is slightly misleading in that a child may have improved in performance, but the gain was not of sufficient magnitude to progress to the next quartile. In two of the subjects, Numbers 2 and 8, there was improvement in intelligibility. However, they were in the upper quartile to begin with and the broad groupings used do not take minimal gains into account. The adjusted total of children showing imitative sound production gains could be larger if the measurement were finer. Eight of the 12 children increased verbal output as measured by sentence length. Behavioral trends were positive as 11 of the 12 children were improved in awareness of, and responsiveness to, oral communication.

No vast changes had occurred. Nevertheless, the first goal, an improved attitude toward communication, had been realized and a greater amount of verbalization was evident.

B Period. Pronounced advances from the preceding evaluation were made by five of the children in imitating words correctly. Minimal, but not sufficient improvement for a demonstrable gain was shown by the remaining seven children. Advances in intelligibility were demonstrated by six of the children and gains were made in sentence length by all but Numbers 1 and 12. Improved communication interaction was observed in eight of the children.

[2]Observations and responses to noise producing objects indicated that hearing was adequate. This was later verified through play-audiometry and/or speech imitation, speech discrimination and in responses to gross sounds.

From the initial examination to the final or *B* evaluation, the following results were apparent:

1. All of the children improved in their ability to imitate sounds. Progress was gradual and did not always show up because of the broadness of the measurements. Since most of the children at the start of therapy were at a level of producing grunts, their final production represented moderate success. Four of the children were able to produce all of the consonants within phonemic limits, and said more than half the sounds correctly. Only one of the remaining three was still unable to produce voluntarily more than 12 consonant sounds.

2. While a discrepancy is bound to exist in a comparison of the production of sounds in a clinical situation involving imitation and in purposive spontaneous speech, steady, but slow progress was also noted in the intelligibility of spontaneous speech. All children but Numbers 1 and 12 had advanced; three of the children, Numbers 2, 5, and 8, were considered understandable for the most part.

3. Oral language development as measured by the number of words used in a sentence had improved to the extent that six of the children had attained a maximum of four or more words. Three others were at a peak of three words in a sentence. Two of the three remaining, Numbers 1 and 12, had not progressed beyond one-word or isolated sound to indicate things.

4. Communication interaction was bettered in all of the children with seven children improving to the extent that they would initiate conversation and respond with verbal answers and actions which were appropriate to the verbal stimuli. The remaining five children would at times be co-operative but on other occasions would also demonstrate mildly aberrant behavior such as negativism, hyperactivity and withdrawal.

Conclusions

Compared to normal developmental gains, the improvements of the children were pathetically meager for the amount of time therapy was in progress. Subjects such as these, however, can be judged only on an individual basis. Where psychopathology is operative as in these children, the progress shown by most of the children could be designated as significant. A visit to most institutions for the retarded will turn up a large number of adult subjects who have been mute for many years. Their case history folders contain information which is analogous to that of the children in this study. Perhaps it might be conjectured that had these silent children received language and speech therapy during early institutionalization they would not have remained mute.

An illustration of one of the children who seemed destined for a nonverbal life was the child designated as Number 10 in Table 1 and Figure 1:

> Dick is a post-encephalitic child with no motor or hearing defect. He was first seen at 4.8 years of age. An occasional grunt, used indiscriminately, comprised his total verbal output. No imitative oral responses could be elicited. Communication contact was pointedly evaded and he was extremely hyperactive. Gestures were infrequently used to indicate what he wanted. The prognosis made by physicians was that he would never develop the use of speech. At 6.8 years he was imitating sounds and producing word approximations. Spontaneous speech was limited to one-word sentences, but symbol meaning was clear only when the subject was known by the listener. Responsiveness and contact were improving. At 8.2 years he was able to imitate most of the consonant

sounds; spontaneous speech was frequently understandable although still limited in output. Phrases and sentences such as 'open the door,' 'your green car,' 'boy drink milk,' objects and picture naming, and ready responses to greetings were indicative of a much improved communication adjustment.

It can be inferred from this investigation that the communication dysfunctioning of these brain damaged retarded children is directly related to their cerebral lesions. On the other hand, the psychological overtones inhibiting their speech and language development must also be considered as responsible in part for the continuing of their delayed communication. It appears that in many instances the situational stresses and resultant anxieties play their part in inhibiting the oral language functioning beyond the limitations imposed by their physiological impairment.

On the basis of observations made over a period of several years of therapy with these 12 brain damaged, retarded children, as well as many similarly afflicted Training School children whose language development was delayed, it appears warranted to conjecture that:

1. Improvement in oral communication, although limited, is possible with retarded, brain damaged children who are not motor handicapped. The program must be a long-term project and must be a personalized intensive treatment program.

2. The longer communication habilitation is delayed, the greater is the anxiety the retarded aphasoid child demonstrates toward such therapy.

3. Behavior disturbance as well as neurologic factors limit the communication potential of these children.

4. Children such as these whose oral expressive ability is severely limited at a C.A. of seven years and whose generally retarded functioning contains overtones of behavior disturbance will attain at most rudimentary language patterns. There may be an occasional child who develops beyond his prognosed potential, but the possibility of attaining a normal level of development in speech and language remains remote.

Summary

Twelve brain damaged institutionalized children who were mentally retarded and whose speech and language development were severely delayed were selected for long-term speech therapy. Evaluations were made of their oral communication abilities at their entrance examination, again at 18-24 months later and, finally, 36-42 months after their initial examination. Measurements and observations were made of their abilities in word imitation, intelligibility of spontaneous speech, sentence length and communication attitudes. After three-to-four years of therapy varying improvement was seen in all measures. Compared to normal maturation gains, the observed improvements were meager, but it was suggested that these children would not be mute in later development as were older institutionalized children and adults with similar symptoms. Based on observed changes, it was felt that improvement in communication was possible with brain damaged, retarded children who are not dysarthric. If communication, however, is severely limited beyond a chronological age of seven years, these children will, in most instances, rarely attain more than rudimentary speech and language development at a level which still enables them to express simple feelings and wants. It was also surmised that behavior disturbances as well as neurologic factors

limited the communication potential of these children.

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Communication Centered Speech Therapy

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Communication Centered Speech Therapy is a product of the contributions from several related fields. It draws heavily in its formulation from the field of speech habilitation for techniques for using communication and social interaction in group speech therapy and for such procedures as ear training, mirror work, speech games, *etc.* It also depends heavily upon the fields of education, psychology and social group work, both for learning principles and for techniques which utilize group process.

In the speech and hearing program at San Francisco State College, a variety of teaching and therapy techniques have been tried, some of which work well together and satisfy certain basic principles of effective therapy. These procedures have been combined into an eclectic approach to speech therapy in which group process is an essential tool, enabling the client to develop success in interpersonal relationships and permitting the establishment of a communicative context in which speech may be practiced in meaningful activities.

One of the principles to evolve from therapy in which realistic activities are the vehicle for speech learning is that communication is the nucleus or center of the speech learning process. This concept appeared to be so cogent to the formulation and practice of speech therapy in all its aspects that the name *Communication Centered Speech Therapy* was selected to identify this combined approach whose principles are described here and which the staff at San Francisco State College is further defining, testing and refining.

Communication

To understand the importance of communication in speech learning and speech therapy, it will be necessary to consider briefly the nature of normal speech development. It has been noted that speech develops according to a certain sequence. The classical description of speech development includes the stages of *reflexive vocalization, babbling, lalling, echolalia,* and *true speech* (2).

At a certain period nearly all infants are able to babble, presumably

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because of physical maturation. When hearing develops to a certain stage, the child can imitate himself (lalling). Later, when his ability to discriminate sounds and to make fine adjustments of the speech mechanism is developed, he is able to imitate others (echolalia). Ultimately, the child is able to use sounds and words in a meaningful way which is called true speech.

This classification of stages of normal speech development is chiefly in terms of speech production, the mechanics of speaking, the peripheral aspect of speech. It focuses our attention on the 'tool' with which we speak, the tool by which we communicate, rather than on the more basic, underlying aspect of speech which actually precedes the true speech stage, namely, communication.

To clarify the role of communication in speech learning, two statements are made here and evidence brought to support them: (1) Communication is the central and most important aspect of the speech learning process, whereas (2) the speech tool or speech product is simply a by-product, developed out of successful communicative experiences.

Perhaps our understanding of the contribution of communication to speech learning may be clearer if it is examined in the light of basic learning principles. Dollard and Miller (*3*) suggest that there are four essential factors in learning: motivation, cue, response and reward.[1] Of these four, the role of communication in speech development is most clearly indicated in the *motivational* aspect of the speech learning process.

[1]Reward is itself sometimes defined as motivation in the learning process. Also, punishment is sometimes described as an 'eliminating' factor in learning as compared with reward as a 'reinforcing' factor.

Motivation

If one asks what it is that motivates a child to learn to talk, most people in the speech field will agree that he learns speech so that he can communicate: to make wants known, to express ideas, thoughts and feelings, and to influence and interact with other people. This is the motivation for speech learning. A child learns to speak because he needs speech to communicate more effectively.

Now, what is the motivation for speech learning as it is traditionally described? Why does a child babble? Is his motivation to communicate? The infant may please the parents with his babbling, but he doesn't make his wants known by babbling. Babbling is usually described as an exercise of the speech mechanism, not of the communicative function.

Why does a child imitate himself? Not to communicate to anyone, except possibly in his own private world. The explanation of speech learning in terms of the lalling stage adds little to the understanding of the basic motivation to learn. Why does he imitate others? It has been suggested that he wishes to be like the mother or to renew the image of the loved adult by sounding like her. This does not explain the process of communication in speech learning but only the imitative process by which even birds may acquire the ability to produce speech sounds.

The motivation in speech learning cannot be fully understood in terms of the classical sequence of speech development. This essential learning factor can be explained satisfactorily only in terms of the communication process which begins at birth and has its own sequence of development to follow.

The infant, in his reflexive vocali-

zation, very early makes different sounds for different reasons. An expression of pleasure is different from a cry of pain. And, as he makes these sounds, some loving adult responds with appropriate rewards and satisfactions. This is the beginning of speech learning. It is communication by use of nonverbal communication skills, and it continues to be nonverbal until the true speech stage. But the infant does communicate and must be rewarded if he is to increase the scope of his communicative relationships and the complexity of his communicative ability. As he practices speech sounds in speech fun and in imitation of others, he increases his repertoire of refined speech tools with which to communicate and makes them part of his communicative behavior whenever they are available to him. Their availability depends upon his physical maturation, upon his imitative practice and upon his need for these speech tools in communication.

The statement was made that speech is a by-product, developed out of successful communicative experiences. It is not a chicken-and-egg situation: which comes first, speech or communication? Speech is not learned before communication can take place. The infant learns to communicate before he learns to speak and the desire to communicate and the ability to communicate nonverbally must develop and improve from infancy if imitated words are to become a part of the communicative equipment.

Communicative Relationships

There is considerable evidence that normal speech patterns develop out of successful communicative relationships. It is known that most children who come from happy homes develop normal speech; but where a child is deprived of rewarding communicative experiences, speech problems and personality problems frequently develop (*5*). Children whose infancy was spent in orphanages or hospitals have been found to have delayed speech development (*4*). Overprotection and overindulgence, rejection and family conflicts have been described as emotional factors in poor speech learning (*4*, *6*). A child does not retain infantile speech patterns simply because of lack of speech stimulation or because of poor speech models. It is more likely that he speaks this way because of failures or difficulties in coping with some of his communicative relationships.

Implications

If the above explanation of speech learning is considered for its implications for speech therapy, it may be inferred that speech therapy should heavily emphasize improved communicative relationships through improving the context in which the client has daily communicative experiences and through improving the client's total communicative behavior, including his speech defect. This means, in the first place, that the home and school relationships of the child should be analyzed and changes made that will contribute to the child's greater success in his communicative experiences and which will supplement and reinforce the child's speech training. One of the important principles of Communication Centered Speech Therapy is that the speech therapy program should be coordinated in every way possible with the speech development program of the home and school. Parent counseling and teacher conferences are essential attributes of a coordinated home, school and therapy approach. Through work

with parents, family relationships of the speech handicapped child may be improved so he will experience greater success in communicative interaction at home. The child's classroom communicative context may likewise be improved through the cooperation of his teacher and therapist.

In addition to improving the child's daily social matrix, the reinforcement by parent and classroom teacher of improved speech production is a major component of Communication Centered Speech Therapy. Emphasis on practical communicative responses learned in realistic communicative situations builds carry-over into the speech lesson which is readily reinforced by parent and teacher, even inadvertently, if not through cooperative planning by therapist, teacher and parent. The place of teacher-parent participation in the speech development program deserves elaborate consideration. However, discussion of therapy in this paper is confined chiefly to work with the child himself.

In therapy with the child, as in the home and classroom program, emphasis is on improved communicative relationships. The goal of therapy then becomes: to improve the client's communicative effectiveness through improvement of his communicative relationships, his adjustive behavior and his speech production.

In Communication Centered Speech Therapy with the client this goal is accomplished through five general steps, each of which overlaps the others.

Determining Group Needs. To assess group needs and the needs of individual group members, group activities are conducted which permit the expression of needs so they can be evaluated. The quiet conformity of children in some classroom settings yields little information as to their needs in communicative relationships. Interaction in a group of five or six children, on the other hand, reveals the child's tendency for withdrawal, aggression, attention-seeking, lack of cooperation, need for approval, *etc.*

Speech therapists are sometimes afraid of this procedure because a group activity in which the expression of needs is not penalized or limited may appear to be less controlled than is usual in the orderly conduct of classroom activities. It is somewhat difficult to learn how to conduct a group so that needs are expressed without exercising too much authority, on the one hand, or permitting too much laissez-faire control on the other.

Unifying the Group. In the unification of therapy groups, benefit may be gained from the years of work in psychology and education with groups of children out of which has grown the concept of group process. To insure an adequate working group relationship in which group process may develop, five or six children are selected in terms of the roles which each may play in achieving a balanced group structure, *i.e.*, one leader, not all withdrawn, more than one girl or boy, *etc.* As they meet together, they engage in activities which stimulate and require interaction and cooperation: games that call for cooperative play rather than individual play, sharing of toys, and taking turns in building and coloring and discussion of things of interest to the group. Group process encourages the children to exert leadership in the group and to cooperate, to develop respect for others and for the rights of the group as well as for the rights of individuals. It provides an effective ve-

hicle for the improvement of adjustive behavior.

Arranging Activities Which Evoke Communication. In arranging group activities which encourage group unification, emphasis is placed upon interaction which evokes oral communication. All interaction involves communication, but some activities require more talking than others. Sharing a viewer or kaleidoscope requires more communication than coloring individual pictures but less communication than making rules for a ring toss game or planning a party.

Arranging Activities Which Evoke Specific Responses. In arranging for communicative interaction, it is possible that specific adjustive and speech behavior be evoked. Herein lies the great power of Communication Centered Speech Therapy. It is here that the basic motivation for speech learning is brought into speech therapy; that *communication* becomes the motivation for speech learning rather than *imitation.* The child learns to make a speech response because it has power for him, because the speech response causes other people to do something for him. If the therapist asks the child, 'Do you want a piece of paper or a crayon or a turn?' and the child says, 'Yes,' his response has power; it has communicative value.

The autistic child who pays little attention to his environment may be motivated to communicate by just such simple experiences. He observes that others obtain desirable playthings by saying 'yes,' so he may be willing to try, if not by saying 'yes,' perhaps by nodding his head or by making eye contact for a brief moment which may be the beginning of speech learning for him.

The practice responses which it is desirable to evoke should have utility and communicative power. The responses the therapist chooses to practice in therapy and the activity she arranges to evoke the practice responses should be weighed for their effectiveness in communicative interaction and for their naturalness in the client's daily life experiences. The speech responses and therapy activities should also be selected for their value in encouraging appropriate adjustive reactions, such as taking turns, *etc.*

Practicing Specific Speech Sounds. In the field of speech habilitation, therapists have traditionally devised practice material which could be fitted into poems, word lists, speech games, *etc.*, with major concern for the number of times the practice sound could be evoked from each child and not enough concern for the communicative value of the practice material or of the learning context. Since normal speech develops out of successful communicative relationships, the first concern in speech therapy should be the development of skills in communicative relationships out of which adequate vocabulary and adequate articulatory and other speech skills will naturally evolve.

Most speech therapists know of instances where children of preschool age, whose speech was unintelligible, have attended a nursery school where no formal speech therapy was given, yet in a short time have acquired intelligible speech, probably because of increased opportunity for successful communicative interaction. Speech therapists should take better advantage of the contribution of increased success in communicative relationships to the improvement of speech problems. Skill in correcting speech sounds can be combined naturally in a communication centered speech therapy with the rehearsal of adjustive behavior and

communicative responses. All that needs to be done is to use the speech responses produced in group interaction as the practice material for improving speech production. In problems of articulation, such responses as 'yes' provide excellent opportunity to practice the imitation of speech sounds in a communicative context. These speech sounds can be practiced in a manner similar to that described by Backus and Beasley (*1*), *i.e.*, taken out of the word context if necessary for isolated sound practice, but returned to the word for use in conversational speech as soon as possible.

Associational Cues

There are a number of basic principles of Communication Centered Speech Therapy, some of which have been mentioned here. Others cannot be discussed in the scope of this paper. There are, however, four important ways in which speech learning may be made more permanent which deserve mention:

1. Therapy should be conducted with groups of children whose interests are similar to those of the client and who are selected in terms of balanced group roles.

2. Materials and equipment used in therapy should be similar to those used by the client in his daily activities.

3. The practice speech responses should be those which have practical application to the client's daily communication experiences.

4. Speech responses should be practiced in association with appropriate gesture and body action.

Establishing these four conditions in speech therapy helps to provide associational cues in the learning situation which are similar to those in the performance or real life situation and thus insure carry-over of learning from the clinic to the child's daily life. An example of speech therapy with young children illustrates how some of the principles of Communication Centered Speech Therapy may be applied.

Typical Therapy Session

A typical lesson usually involves three parts:

1. The first part may be thought of as an evaluation period for both group and individual communicative needs since it represents a fairly typical life situation in which the group shares communication in a free speech setting. The length of time needed varies with different groups. When a group is well integrated and has developed an effective means of dealing successfully with social situations so that each member has a desire to remain in the group and be a part of it, this portion of the lesson may involve only the few minutes necessary for greetings. To this may be added sharing of ideas that children are anxious to tell. When relationship problems exist within the group, additional activities may include such things as discussing what the problem is in an effort to find a solution, or planning a project together in order to help the integrative process. An important aspect here is that cross-communication among the children should be the dominant feature with therapist interference at a minimum.

2. The second part is structured to give the children an opportunity for rehearsal of the specific response to be practiced in the lesson. This response may be incorporated in a short story. The story is arranged in such a way that the refrain will be repeated until the children can antici-

pate it and join with the therapist, thus practicing the response while listening to the story, with minimal communicative responsibility. Practice on a speech sound within the responses can be made at this time. The story may then be dramatized.

3. In the reality activity part of the lesson, circumstances are arranged so that the practice responses are evoked as a part of the natural interaction of a real life activity. Toys and materials are provided which call for certain types of interaction and communicative behavior. Group tasks are evolved in which group members naturally communicate with the speech responses previously rehearsed. Among the most powerful communicative responses are requests. It is not difficult to arrange circumstances which almost require that each child make requests of others in the natural sequence of group activity. And requests have the added value of demonstrating the power of speech through immediate concrete action taking place as a result of its use.

In therapy for older children these same principles apply in a slightly different way. For them, therapy must provide more complex communicative experiences geared to their increasingly complex reality. For example, rehearsal through a story is not appropriate at this level and may be replaced by discussions from which natural responses evolve.

The measure of effectiveness of Communication Centered Speech Therapy is in terms of a variety of attributes and principles. However, in simple terms, *speech therapy is communication centered if the learning situation and the practice speech responses have optimum communicative power.* If this is accomplished, with all its implication for the client's social adjustment as well as improved speech production, the total goal of speech therapy may truly be achieved.

The effectiveness of Communication Centered Speech Therapy is constantly being evaluated in school and clinic therapy programs with clients at various ages. At San Francisco State College it is currently under formal test in a federal research project in speech training of mentally retarded children, the results of which will soon be available.

It is encouraging to find that speech therapists throughout the country are emphasizing improved communicative relationships as an essential aspect of therapy. It is hoped that contributions will continue to be made so that a communication centered approach to therapy for problems in speech and hearing may be more clearly defined and constantly improved.

Summary

Communication Centered Speech Therapy is an eclectic approach combining learning principles and therapy techniques from various fields of human behavior. Its formulation is based on the concept that communication is the nucleus of the speech learning process and that the motivation in speech learning is the motivation to communicate rather than to imitate. In therapy, this motivation derives from group relationships. It is reinforced and extended into the child's daily life through closely correlating the child's communicative activities in therapy, school and home.

Communication Centered Speech Therapy emphasizes five general aspects which may proceed simultaneously as group structure develops: (1) determining the needs of the group and the needs of individual

group members, (2) unifying the group through integrative group activities, (3) arranging activities which evoke communication on the verbal as well as nonverbal level, (4) arranging activities which evoke specific adjustive behavior and specific speech responses and (5) practicing specific speech sounds in context, removing them for isolated sound practice if necessary, but returning them for further practice to the original context.

The employment of these five steps in speech therapy recognizes that improvement in speech production and improvement in adjustive behavior are closely related and may be achieved in therapy both directly and indirectly: (1) Both may be improved naturally as a result of training in communicative relationships. (2) They may be improved directly through practice of specific speech responses and specific adjustive behavior within the context of realistic social interaction. This emphasis in Communication Centered Speech Therapy on adjustment to speaking situations as well as on speech improvement is consistent with the broad goal of speech therapy: to improve the client's communicative effectiveness through improvement of his communicative relationships, his adjustive behavior and his speech production.

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A Multi-Evaluational Study Of Aphasic And Non-Aphasic Right Hemiplegic Patients

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Aphasia is a language disorder associated with brain damage. It is characterized by loss or impairment in the use of spoken or written symbols for the formulation, reception or transmission of ideas. Dysphasia is a term used to designate a milder degree of such disturbance.

Pure aphasia, *i.e.*, impairment limited to a single modality of symbol intake or output, either receptive or expressive, is practically never observed. Language defects most commonly observed in aphasics are usually mixed. The predominantly expressive type shows the greatest disturbances in the ability to express ideas through speech or writing. In the predominantly receptive type, the disturbance is in the ability to comprehend spoken or written symbols. In some cases all language processes, both receptive and expressive, are severely disturbed. This condition is commonly referred to as global aphasia. Less commonly observed are amnesic (nominal) and semantic aphasia. In amnesic aphasia the patient has little difficulty in speaking or understanding of words, but the general meaning of what he hears or reads escapes him.

Much of the available literature on aphasia is based upon wartime experience with persons who developed language dysfunction secondary to brain injuries sustained during periods of unusual emotional strain.

Approach

To study the symptom complex of aphasia as it presents itself in everyday practice, a study was organized at the

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Jewish Chronic Disease Hospital in Brooklyn, with the following ultimate specific objectives:

1. To investigate possible cortical localization in relation to the symptom complex of aphasia.

2. To determine whether there is a relationship between the etiological factor responsible for the condition and the specific type of aphasic impairment which the patient manifests. For example, does a patient whose aphasia is secondary to a cerebrovascular accident show a different array of language disabilities from the patient whose aphasia is caused by a brain tumor or traumatic head injury?

3. To ascertain whether right brain damage produces language impairment, and if so, what type of impairment characterizes the patient with left hemiplegia.

4. To determine the relationship between premorbid handedness and language disturbance in patients with left hemiplegia.

5. To determine prognostic criteria for aphasics and the possible therapeutic implications.

A multiphasic approach is being used in this investigation. Each patient receives a neurological examination, a psychological and audiological evaluation, and an electroencephalographic study.

This part of the report deals with one phase of the study, an investigation of a group of 26 patients who sustained a cerebrovascular stroke (due to thrombosis, embolism or hemorrhage) involving the left cerebral hemisphere resulting in right hemiplegia. Twenty of these patients had aphasia; six patients had no aphasia. One patient was admitted to the Jewish Chronic Disease Hospital within 24 hours after sustaining a cerebrovascular stroke. All the other patients were transferred to this hospital from other institutions where they were taken following the acute episode. Sixteen of the patients were seen within the first year following the stroke; the remaining 10 patients were seen within two or more years following the onset of the stroke.

Discussion

There is considerable difficulty in determining whether the cerebrovascular accident is due to hemorrhage, thrombosis or embolism. Usually cerebral hemorrhage is of much greater import as far as life is concerned. Cerebral embolism most often occurs in younger people who have some pathologic state, usually cardiac, predisposing them to embolization. Merritt (*6*) states that in an analysis of 407 patients with cerebrovascular accidents, the diagnosis of cerebral thrombosis was made in 82 per cent, cerebral hemorrhage in 15 per cent, and cerebral embolism in three per cent. In our group of right hemiplegic patients, 18 had an admitting diagnosis of cerebral thrombosis, six of cerebral embolism, and two of cerebral hemorrhage.

A controversial problem is the question of cortical localization. The theories of the early extreme localizationists, the so-called 'diagram makers,' are no longer generally accepted. The pendulum appears to have swung in the other direction. The modern tendency seems to be to minimize the effects of cortical localization of language function and to emphasize the nature of the aphasic disorder.

Language is an intellectual function. To transform a spoken or printed word or sentence into a complete percept requires intricate cortical processes. To localize this function to limited cortical areas would appear to be unwarranted. It would seem, and there are those who believe, that in

aphasia the critical factor is the quantity of brain tissue involved rather than some localized brain area. Some believe that speech is the function of the entire brain.

Whether or not this is so, there is evidence that size or amount of specialized tissue shows little relationship to function or dysfunction. For example, the average weight of the pituitary is about 0.5 grams and the anterior part of the pituitary alone (the adenohypophysis) produces at least 11 types of hormones. Apparently it is not always the size of total mass of an organ that matters. It is remarkable that a unilateral lesion situated in the left cerebral hemisphere in the majority of patients will be associated with a disorder in language function. Wilson (*17*) has pointed out that perhaps this fails to impress us because it is such a commonplace finding.

The cerebrovascular strokes producing hemiplegia and aphasia are most commonly caused by involvement of the middle cerebral artery. The branches of this artery supply the internal capsule, the insula and most of the deep and lateral portions of the cerebral hemisphere. These areas are the inferior frontal gyrus, anterior central gyrus, posterior central gyrus, lower part of the superior parietal lobule, supramarginal and angular gyri. Language dysfunction usually results when there is damage to some of these middle cortical areas in the left cerebral hemisphere, the so-called 'aphasic zone.'

The central area of language is a cortical region occupying the space between the termination of the optic and acoustic nerves and certain motor areas in the left hemisphere. These association areas have no projecting fibers to the periphery. There is only one pathway to the periphery, and that is the tract which runs through the internal capsule. A lesion there will result in capsular hemiplegia with dysarthria but no aphasia. There is also experimental evidence by Penfield (*10*) as well as pathological evidence by Nielsen (*8*) that differently situated local cortical lesions affect different elements of speech. At the present state of our knowledge it is well to bear in mind, as Nielsen (*9*) has pointed out, that these areas should not be regarded as delimited cortical zones with independent functional capacity but rather as anatomically delimited zones essential to a certain function.

Findings

The principal neurological findings in these patients was right hemiplegia, and the majority had associated

TABLE 1. Type of onset in 26 CVA patients with and without aphasia. TA=thrombosis with aphasia; Tx=thrombosis without aphasia; EA=embolism with aphasia; Hx=hemorrhage without aphasia; T=thrombosis; E=embolism; H=hemorrhage; A=aphasia; x=without aphasia.

	Symptoms								
Onset	*TA*	*Tx*	*EA*	*Hx*	*T*	*E*	*H*	*A*	*x*
Sudden	5	3	6	2	8	6	2	11	5
Intermittent	9	1	0	0	10	0	0	9	1
Total	14	4	6	2	18	6	2	20	6

TABLE 2. Severity of aphasia and accentuation on EEG among CVA patients. There were no cases with frontal accentuation only, and none in whom receptive language disturbance was more severe than the expressive disturbance. Not included in this table are two cases (one TA and one Tx) with no accentuation, one case (TA) with bilateral diffusion, and five cases not tested on EEG.

	EEG Accentuation	
	*Frontal and Posterior**	*Posterior only*
Expressive defect dominant†	7	5
Expressive defect not dominant††	6	0
Total	13	5

*Posterior=parietal, temporal and/or occipital.
†Expressive disturbance greater than receptive.
††Expressive and receptive disturbance equal.

aphasia. Additional findings, in varying degrees, included right-sided hypoanesthesia, right homonymous hemionopsia, and right Babinski. Some of the patients had incontinence of urine during the first few days following the acute episode. This invariably cleared up and they regained full bladder control. The median age of the patients in our study was as follows: thrombosis, 69; hemorrhage, 66; embolism, 47.

There were two types of onset, the sudden and the intermittent. The usual history was that to all intents and purposes up to the time of the stroke the patient was engaged in his daily routine activities. Suddenly, in the majority of cases and frequently while at work, the patient would slump to the floor or fall over in a coma. Soon after, upon regaining consciousness the patient was found to have right hemiplegia usually associated with aphasia.

In some cases the onset was less dramatic. For some days or weeks the patient had some premonitory symptoms such as transient episodes of mental confusion, temporary difficulty in expressing himself, or a weakness of the right arm and leg from which he apparently recovered. After a lapse of several days or weeks the patient, sometimes upon awakening from sleep, was found to have hemiplegia and aphasia. Table 1 gives the type of onset (in relation to the admitting diagnosis) and the presence or absence of aphasia. Further elaboration of this relationship will be given in the section on psychological evaluation.

On electroencephalographic[1] examination the involved hemisphere was consistently lateralized to the left side. We also endeavored to determine the accentuation of the disturbance, whether it was predominantly frontal or posterior. A tabulation of results showed that patients with aphasia showing predominantly receptive involvement or equal disturbance in expressive and receptive language functions tend to show involvement of both frontal and posterior areas of the cortex. As indicated in Table 2, patients with predominantly expressive language involvement may show either frontal and posterior disturbance or posterior dis-

[1]All electroencephalographic findings were interpreted by A. J. Berman, M.D., Jewish Chronic Disease Hospital, Brooklyn, New York.

turbance only.

Disturbances in language function constitute only a part of the symptom complex of aphasia. The aphasic person often demonstrates general intellectual deficit and personality changes, although not to a degree that he is socially incompetent. The premorbid personality of the patient must also be considered and the influence it exerts on the aphasia evaluated.

In addition to the personality factor and its influence on aphasia another factor to be considered is the influence of aphasia on the personality. An aphasic patient is isolated to varying degrees from interpersonal communication. Ziskind (*18*) has recently discussed isolation stress in medical and mental illness. He points out that sensory deprivation is always a concomitant of isolation in man and the human voice is a significant part of the total external stimuli. The aphasic patient as a result of his loss of the ability to communicate with his fellow man may also develop severe anxiety states and depression.

Psychological and Language Evaluation

In addition to language impairment, a significant concomitant of major brain damage is some degree of loss in intellectual efficiency. These patients characteristically show defects of memory, difficulties in tasks calling for sustained thinking and in the organization of unfamiliar material. Goldstein (*3*) regards aphasic impairments as a consequence of a basic disturbance in the loss of abstract thinking ability. Head (*5*) cautions against the assumption that the aphasic patient's intellectual impairment is as great as would appear from his language difficulties. He regards aphasia as a disorder of symbolic formulation and expression and considers it to be basically a linguistic difficulty. Weisenburg and McBride (*16*) state: 'The extent to which intelligence may be said to be affected is a moot point. Some investigators have held that intelligence suffers because language is disturbed, while others have held that language is disturbed because of the intellectual disorder.' Milner (7) found that in left temporal lobe lesions causing aphasia, the test pattern '. . . is likely to be one severe deficit on verbal tests and relatively mild deficiency on nonverbal ones.'

Wechsler (*15*) concludes that patients having a CVA will demonstrate greater defects of intellectual ability when the lesion is in the left hemisphere especially when the lesion is accompanied by aphasic disturbances.

The Wechsler Adult Intelligence Scale (WAIS) (*14*), Wechsler Memory Scale Form 1 (*13*), Harris Tests of Lateral Dominance (*4*), and Eisenson's Examining for Aphasia (2) were administered in this order to each of the subjects individually, by the same psychologist. Since many of the patients were unable to concentrate on the test items for any length of time and were easily fatigued, the evaluation was divided into two to five sessions. In administering the WAIS and the Wechsler Memory Scale, those patients who had difficulty in communication were given only selected performance items. Intratest scores obtained for both groups on the WAIS were compared for any differences of significance.

The results obtained on the Eisenson test for aphasia were correlated with the type of onset and with the electroencephalographic findings.

Rationale for Selected Tests.

1. Wechsler Adult Intelligence

Scale (WAIS) is a comparatively new revision of Wechsler-Bellevue Form 1, providing a measurement of intelligence of adolescents and adults ranging in age from 16 years to over 75 years. There are six verbal and five performance tests. These are administered individually, yielding scores which are summed and then converted into an I.Q. The test suggests certain indicators of organic brain pathology such as poor performance on digit span recall, especially digits backwards, block design, digit symbol and similarities. Evidence of pre-traumatic as well as post-traumatic intelligence is elicited during the examination.

2. Wechsler Memory Scale, Form 1, is a concise, easy to administer, individual test of memory function of adults. It is standardized in the same way as the Wechsler-Bellevue Intelligence Scale, and yields a Memory Quotient. The scale is useful in detecting special memory defects in individuals with brain damage. However, it is essentially a test of verbal material, and the individual who has predominantly expressive aphasia with even a slight trace of sensory disturbance is likely to earn a low score.

3. Harris Tests of Lateral Dominance do not give a standardized score, but provide sufficient information to make a clinical judgment possible. The tests require the use of both upper extremities; thus patients with a right-sided hemiplegia are unduly handicapped. The major portion of the tests was therefore discarded, and only three items were retained: (1) knowledge of right and left, (2) hand preference, (3) monocular tests.

4. Eisenson's Examining for Aphasia is a clinical procedure for exploration of language impairment in aphasic patients. It includes tests for the agnosias, apraxias, automatic speech, alexia, agraphia, and acalculia. The test usually takes from 45 to 90 minutes to administer. In some cases, however, the testing period takes considerably longer. Severely involved patients who nevertheless try to respond may take more than two hours

TABLE 3. A comparison between the median scaled scores of 26 aphasic and nonaphasic patients on the Wechsler Adult Intelligence Scale. Sixteen aphasics could not be tested on the Verbal Scale, and one aphasic could not be tested on the Performance Scale.

WAIS	*N*	*Aphasics*	*N*	*Nonaphasics*
Verbal Scale				
Information	4	6.0	6	8.0
Comprehension	4	5.0	6	7.5
Arithmetic	4	4.5	6	8.5
Similarities	4	3.0	6	2.5
Digit Span	4	3.5	6	6.5
Vocabulary	4	4.5	6	6.5
Performance Scale				
Digit Symbol	19	0.0	6	0.0
Picture Completion	19	1.0	6	5.0
Block Design	19	1.0	6	4.5
Picture Arrangement	19	0.0	6	3.0
Object Assembly	19	1.0	6	4.5

to complete the examination. We have found it advisable in these instances to administer the inventory in two sessions.

Results. Both groups of patients, those with and without aphasia, did poorly on the Performance Scale of the WAIS. The Digit Symbol subtest which involves visual acuity, motor coordination and speed was found to be most difficult by both groups. This might be explained by the fact that all the patients except one were previously right-handed, and as a result of the stroke were unable to use the preferred right arm. Sixteen of the aphasic patients could not be tested on the Verbal Scale of the WAIS. In comparing the Performance Scale scores, patients with aphasia showed significantly lower scores than patients without aphasia (Table 3). Both groups have shown comparatively good scores in Arithmetic, Block Design, and Object Assembly, all of which require abstract reasoning. Bower and Becka (*1*) in their study of aphasics have also arrived at the same conclusions. Our results do not support Goldstein's (*3*) hypothesis that aphasic patients show a marked impairment of abstract reasoning ability. These results do not agree with the psychometric test patterns for organic brain pathology described by Wechsler (*15*).

All patients were examined for tactile agnosia (astereognosis). In this test the patient is asked to identify objects placed in either hand while his eyes are closed. It was found that 18 of the 20 aphasic patients were unable to identify the object placed in the involved hand. This finding was less pronounced in patients who remained aphasic beyond three months. In the right hemiplegia patients without aphasia two out of the six patients were able to identify correctly the object placed in both hands.

Patients with aphasia due to thrombosis were found to have language disturbance predominantly of the receptive type compared to patients whose aphasia was due to embolism (Table 4). In cases of aphasia due to thrombosis, patients having an intermittent onset tend to show greater involvement in both expressive and receptive areas than do patients having a sudden onset (Tables 4 and 5).

TABLE 4. Degree of receptive involvement and type of onset in 14 CVA patients with thrombosis and aphasia (TA) rated on a nine-interval scale. A rating of 1=no disturbance; 5=moderate disturbance; 9=complete disturbance.

Onset	*Below 5*	*5 or above*	*Total*
Sudden	3	2	5
Intermittent	3	6	9
Total	6	8	14

TABLE 5. Degree of expressive involvement and type of onset in 14 CVA patients with thrombosis and aphasia (TA) rated on a nine-interval scale. A rating of 1=no disturbance; 7=severe disturbance; 9=complete disturbance.

Onset	*Below 7*	*7 or above*	*Total*
Sudden	2	3	5
Intermittent	2	7	9
Total	4	10	14

Audiological Evaluation

Tests. All patients in the study received a complete audiological evaluation, including pure-tone and speech audiometry when these tests could be performed. Pure-tone audiometry included the determination of thresholds for the following frequencies by air conduction in each ear: 125, 250, 500, 750, 1000, 1500, 2000, 3000, 4000,

6000 and 8000 cps. When a loss of 10 db or more was found on air-conduction measurements for frequencies in the 250-4000-cps range, a bone-conduction test was performed. Speech reception thresholds were determined for each ear and binaurally. Discrimination was tested at 40 db above the speech reception threshold and in noise using a signal to noise ratio of plus 10, *i.e.*, the intensity level of speech exceeded the level of the noise by 10 db. Disc recordings of spondaic and phonetically balanced words from the Central Institute for the Deaf which are processed by Technisonic Studios (Lists W-1 and W-22) were used for tests of discrimination in noise. The Doerfler-Stewart test was also performed whenever possible.

Results. This paper reports the results of the pure-tone audiometric tests performed and the degree to which standard speech audiometric tests could be applied to the patients evaluated.

Twelve of 23 patients tested via pure-tone audiometry were found to have normal hearing. Hearing was considered normal when the pure-tone average (500, 1000, 2000 cps) did not fall below 10 db in either ear. Of 17 patients with aphasia, nine had normal hearing. Of six patients without aphasia, three had normal hearing. There appears to be no apparent relationship between the presence and absence of a hearing loss in the speech frequency range and the presence and absence of aphasia in the right hemiplegic patients studied.

Hearing losses were classified according to the average pure-tone loss for the speech frequencies (500, 1000, 2000 cps) in the better ear. When the pure average tone was between 10 and 30 db, the loss was classified as 'slight.' Losses between 30 and 55 db were classified as 'moderate,' between 55 and 75 db as 'severe' and below 75 db as 'profound.' These ranges refer to the hearing loss in the better ear. Of the eight patients with aphasia found to have hearing losses, six had 'slight' losses and two had 'moderate' losses. None showed severe or profound losses. One patient showed a severe unilateral sensori-neural hearing loss without recruitment. Of the three patients without aphasia found to have hearing losses, one had a 'slight' loss, one a 'moderate' loss and one a 'severe' loss.

Pure-tone audiometric data were further analyzed to determine the incidence of high frequency losses of hearing in each of the two groups studied. A high frequency loss of

TABLE 6. Classification of hearing loss in 26 CVA patients with and without aphasia. TA=thrombosis with aphasia; Tx=thrombosis without aphasia; EA=embolism with aphasia; Hx=hemorrhage without aphasia; T=thrombosis; E=embolism; H=hemorrhage; A=aphasia; x=without aphasia.

	Symptoms								
Type of Loss	*TA*	*Tx*	*EA*	*Hx*	*T*	*E*	*H*	*A*	*x*
Normal hearing	5	1	4	2	6	4	2	9	3
Conductive	0	0	0	0	0	0	0	0	0
Sensori-neural	5	3	1	0	8	1	0	6	3
Mixed	2	0	0	0	2	0	0	2	0
Not tested	2	0	1	0	2	1	0	3	0
Total	14	4	6	2	18	6	2	20	6

TABLE 7. Speech audiometry testability for 26 CVA patients with and without aphasia. TA=thrombosis with aphasia; Tx=thrombosis without aphasia; EA= embolism with aphasia; Hx=hemorrhage without aphasia; T=thrombosis; E=embolism; H=hemorrhage; A=aphasic; x=without aphasia.

	Symptoms								
Testability	*TA*	*Tx*	*EA*	*Hx*	*T*	*E*	*H*	*A*	*x*
Testable	3	2	2	2	5	2	2	5	4
Partially testable	0	2	0	0	2	0	0	0	2
Not testable	8	0	3	0	8	3	0	11	0
No test tried	3	0	1	0	3	1	0	4	0
Total	14	4	6	2	18	6	2	20	6

hearing was defined as a loss greater than 20 db at two or more of the following frequencies: 3000, 4000, 6000 and 8000 cps in either ear. Of the 20 right hemiplegic patients with aphasia, 15 were found to have such high frequency losses of hearing. All six patients without aphasia showed high frequency losses of hearing. The age range of the patients in our study must be considered in evaluating these findings. High frequency sensori-neural losses of hearing due to presbycusis are fairly common in persons over 50 and cannot be attributed to the cerebrovascular accident *per se*. Furthermore, several of the patients in our study presented histories of previous noise exposure which may also result in hearing losses in the high frequency range.

Of 11 patients in both groups found to have hearing losses, nine had losses of the sensori-neural type and two had combined losses in which both conductive and sensori-neural components were present. These results are shown in Table 6.

Speech audiometric tests were performed whenever possible. These results will be reported in a future paper which will include a larger series of patients with both right and left hemiplegia. Several observations will be made in the present paper on the applicability of these tests to the present group of patients.

Nearly all of the patients without aphasia could be tested via standard speech audiometric procedures. Eleven out of 16 patients with aphasia could not be tested completely via speech audiometry. Five patients with aphasia could be completely tested via speech audiometry. Testability of patients via speech audiometry is summarized in Table 7.

In contrast to other studies reported on hearing loss in aphasic patients, our population was limited to patients whose aphasia resulted from cerebrovascular accidents. Street's (*11*) finding that 88 per cent of a group of 90 aphasic patients had hearing loss is based upon a population which included aphasias due to cerebrovascular accidents, traumatic head injury, and tumor cases. It is possible that the hearing loss found in some of the aphasic patients studied by Street is secondary to the traumatic head injury sustained, a factor which did not operate in patients whom we studied. Furthermore, Street considered 125-2000 cps as the 'speech frequency range.' If a patient had a loss of hearing at the 125- and 250-cycle frequencies only, he was classified by Street

as having a 'speech frequency loss.' In our study, classification of hearing loss was based upon the patient's hearing in the 500-2000-cps range which we considered to be the 'speech range.'

Terr, Goetzinger and Rousey (*12*) conclude that a *low* frequency loss of hearing is characteristic of many adult patients with aphasia and cerebral palsy. We have found losses in the high frequency range much more common than low frequency losses in patients studied thus far. We have encountered very few aphasic patients with losses of hearing limited to the low frequency range.

Summary and Conclusions

This is the first report of a continuing multidiscipline study of aphasia. Twenty aphasic and six nonaphasic right hemiplegic patients who sustained cerebrovascular accidents were investigated. These patients received neurologic, psychologic, audiologic and electroencephalographic studies. Results of these examinations were analyzed to determine whether significant differences exist between right hemiplegic patients with aphasia compared to right hemiplegic patients without aphasia.

With full awareness of the limitations posed by the numbers of patients as well as the ages of the patients, the following observations were made:

1. Twenty out of 26 right hemiplegic patients were found to have aphasic involvement.

2. Aphasic patients with an illness of intermittent onset show greater disturbance in both receptive and expressive areas than those having a disease of sudden onset.

3. Patients with aphasia due to thrombosis were found to have language disturbance predominantly of the receptive type in contrast to patients whose aphasia was due to embolism.

4. On the Performance Scale of the WAIS, patients with aphasia showed significantly lower scores than patients without aphasia. Both groups showed comparatively good scores on subtests requiring abstract reasoning ability.

5. Electroencephalographic studies showed that patients with predominantly expressive language involvement may show either frontal and posterior accentuation or posterior accentuation only. No cases were found of frontal accentuation only.

6. Hearing loss seems to be present in the same proportion for aphasic and nonaphasic patients. It is possible that this hearing loss may be explained in part by the factor of age rather than by brain damage *per se*.

Further investigation is in progress on a larger number of patients.

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Role Of Conditioning In GSR Audiometry With Children

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The process of GSR audiometry with children is generally assumed to rest on the well-established phenomenon of Pavlovian or classical conditioning. The child is said to be conditioned to elicit a skin resistance change when a tone or other sound stimulus is heard. This conditioned skin response can then be used as the audiometric indicator of hearing.

Historically, threshold determination by conditioning has been common with lower animals and has been accomplished with cats (*26*), dogs (*5*), guinea pigs (*25*), rats (*19*) and others. As early as 1928 such a procedure was suggested for assessing hearing capacity of the newborn human infant (*1*). While it is true that the general procedures employed today in GSR audiometry with children resemble the operations performed in classical conditioning studies of infants and young children (*3*), the actual role of conditioning in the audiometric situation has not been very thoroughly discussed. It is the purpose of this paper to provide such a discussion with special reference to galvanic skin responses of very young children with severe and profound hearing losses.

This is not the first time that the general question of the role of classical conditioning in objective audiometry has been raised. In a recent publication Ruhm and Carhart (*22*) made the following statement: 'It still remains to be demonstrated whether it is possible to achieve classical conditioning of a response involving the autonomic nervous system when the sequence of stimulation is as brief as the maximum which is practical in the clinical application of electrodermal audiometry.'

The evaluation of hearing in young deaf children through galvanic skin responses is a somewhat different matter from studies of conditioning utilizing galvanic skin responses with normal hearing college students in a psychology laboratory. Some of the

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problems that are most important in one situation are much less important in the other. In one situation audiologists are attempting to evaluate hearing; in the other experiments psychologists are generally studying learning. In GSR audiometry, conditioning is used to help sustain or 'hold' a child's tendency to give a GSR to tone. In psychological studies of conditioning, the GSR is used as a response measure to evaluate changes in the parameters of the learning situation.

Review of Principles

Since much of the following reasoning rests upon certain assumptions about what conditioning 'is,' it might be well to begin by stating explicitly certain differentiating criteria which are fairly well agreed upon.

Essential Requirements. By way of definition, the term *classical conditioning* is used to designate a paradigm or pattern of experimental operations. There is an unconditioned stimulus (UCS) capable of eliciting an unconditioned response (UCR); then there is a conditioned stimulus (CS) originally not capable of eliciting the UCR. By means of paired presentation of the two stimuli (usually the CS followed shortly by the UCS) the CS becomes able to elicit a response called the conditioned response (CR) which is related in some obvious way to the UCR. In GSR audiometry the CS is a tone or other sound stimulus, the UCS is usually an electric shock, and the UCR and CR are both galvanic skin responses.

At the present state of knowledge there is still some question as to whether conditioning of autonomic responses (like the GSR) is a mechanical process in which the sufficient requirement for the establishment of a conditioned response is merely an appropriate pairing of conditioned and unconditioned stimuli, or whether some additional intermediate reactive processes are necessary for learning to take place. Most psychological studies have been concerned with factors affecting the amount of conditioning. These factors include CS and UCS intensities, time relations among stimuli, massing versus distribution of trials, continuous versus partial reinforcement, *etc.* It is generally assumed that, if the correct set of limiting factors is employed, the subject will 'learn.'

From the standpoint of the use of conditioned responses in audiometry, it is obviously important that efforts be made to work with an optimum set of the above limiting factors. It is evident from some research studies (*e.g., 17*) that audiologists are striving to determine the optimum conditions. It is also reasonable to assume that reported difficulties in conditioning children with severe losses (*e.g., 11, 12*) may be due to failure to achieve one or more of the conditions essential for learning. The more difficult the hearing case, the more likely is such a failure. For example, in order for a child to condition to a tone, he must hear the tone. Relying only on informal tests, the initial determination may be far from an optimum tonal intensity. Laboratory studies have shown (*16*) that learning is sometimes poorer to an intense tone than to a soft tone; on the other hand, if the tone intensity is too low, conditioning is not likely to occur (27). Stimulus intensity is only one of many variables relevant to the GSR conditioning situation.

Psychologists tend to employ objective criteria to answer the question of whether conditioning has occurred

or not. These criteria involve operations that demonstrate that the response to the conditioned stimulus, after pairing with the unconditioned stimulus, is demonstrably different from what it was before paired stimulation. In other words, conditioning has not occurred unless the subject gives a response to the tone after training which differs from the one he gave before training. It is also necessary to demonstrate that any changes observed are due to the operations of paired stimulation and not due to fatigue, sensitization, and the like. It may be said that all psychological studies require a criterion of learning change and some control against 'pseudoconditioning.'

The authors find these last mentioned matters to be at the center of the differences between the 'conditioning' of audiologists and that of experimental psychologists. In GSR audiometry it is not customary to provide either criteria of learning or controls for pseudoconditioning, although an occasional writer shows concern for these matters. It is the conclusion of the present authors that, whereas the psychologist needs such criteria, the audiologist does not. However, the audiologist needs certain other criteria directed toward threshold measurement and needs to be aware that when he does not employ 'learning' criteria and pseudoconditioning controls, he must be careful when he refers to differences in observed results as differences in 'conditioning.'

Further elaboration of the roles of learning criteria and pseudoconditioning controls in conditioning studies is desirable before an evaluation of their importance in GSR audiometry can be made.

Criteria of Learning. The psychologist generally wants to produce a change in behavior which he calls learning. This involves producing a response in situations where it previously did not occur, or modifying a response which is already there. Both situations require that he gather and utilize information about the characteristics of the response before he introduces the conditions to produce 'learning.' He customarily administers adaptation trials to the conditioned stimulus alone in order to reduce 'unlearned' responses before he starts the paired stimulation training. Then he manipulates experimental conditions to determine the degree to which they influence amount or stability of learned responses. To evaluate his experimental variables, he must have objective indicators of whether or not learning has occurred and usually needs indicators of how much change or learning has occurred.

Note immediately how different the situation is for the audiologist. He doesn't really care whether learning has occurred or not, nor to what extent it has occurred. What he cares about is that he gets a reliable response to tones which he can differentiate adequately from responses to other nonauditory stimuli. If the GSRs to tone are there from the beginning without conditioning or tone-shock pairing, so much the better. Early efforts at objective audiometry tried to exploit the natural responses to tones (*6, 9, 18, 20*), and these studies are still sometimes confused methodologically with those that employ conditioning. On the other hand, such conditioning as is involved may have the primary function of 'holding on to' the response to tone rather than establishing the response to tone.

The conclusion to be drawn is that the audiologist does not need a cri-

terion of 'learning' or of 'conditioning.' What he needs is a dependable response to the sound stimulus and adequate criteria to assure that the response is to that stimulus and not to some other event.

Sensitization. The control of pseudoconditioning is also of paramount concern to the experimental psychologist. If he wants to conclude that he has produced response change (learning) as a result of paired presentation of stimuli, he has to eliminate the possibility that the response change would have occurred anyway due to conditions other than stimulus pairing. For example, the mere introduction of a noxious stimulus (shock) into a situation will lead to increased GSRs to all sorts of stimuli—for the subject becomes sensitized. The pseudoconditioning control provides the logical criteria to differentiate responses due to 'conditioning' and those due to 'sensitization.' This is achieved by including special control groups or control stimuli among conditioning observations.

The difference in goals suggests that the audiologist's need for sensitization control is different from that of other workers. As long as he gets GSRs to tone and can differentiate these from GSRs to nontones, he has his requirements filled. However, close examination of the situation shows it to be complicated, for if a child becomes sensitized, he will not only respond more readily to tones but will also respond to all sorts of other stimuli. It then becomes increasingly difficult to answer the question: Was that GSR due to the tone stimulus or to some other stimulus?

Up to the present time the most important information concerning amount of sensitization has been gained through the use of control trials, *i.e.*, stimulus sequences in which the tone stimulus is not presented. This matter will be discussed more fully in a later section of this paper. Meanwhile, it may be concluded that in GSR audiometry pseudoconditioning controls such as those used by the psychologist studying conditioning are not necessary. What is required is an awareness of processes other than stimulus pairing which can alter the magnitude or number of responses to certain stimuli. These processes must be allowed for in the criteria to differentiate responses due to presentation of a tone and responses attributable to other 'extraneous' stimuli.

Adaptation. Whereas the factor of sensitization leads to an increased rate of GSR responses to most stimuli, an opposing process of adaptation leads to a reduced tendency to respond. It has been demonstrated that successive presentation of some stimuli [tones (*4*), mild shocks (*8*)] are accompanied by reduced GSR response tendency. The subjects probably relax and are less affected by stimulation. Part of any conditioning procedure, therefore, must be directed at reduction of this adaptation on the part of the subject. One common practice is to increase the stimulus intensity periodically during the observational session.

Further study of the course of response adaptation to tone and to different electrical stimuli is needed before effective procedures can be devised. Such a study is under way with both preschool children and college students and will be reported separately.

Requirements

Since the last sections were devoted largely to the question of what the

audiologist does *not* need that the experimental psychologist does need, it next becomes imperative to consider what it is that the procedure of GSR audiometry must have if it is going to be scientifically 'objective.' Two major requirements have already been stated in simplified fashion: (1) There must be a uniform and dependable GSR response to suprathreshold tones or other sound stimuli under test, and (2) it must be possible to differentiate responses due to test stimuli from those due to other internal and incidental stimuli. To these must be added equally important criteria for threshold definition.

Rate of GSR Responding. In conventional audiometric procedures based on voluntary (*e.g.*, finger raising) responses, it is reasonable to presume a very high likelihood that the response will occur if the stimulus is heard. Studies have suggested that this likelihood of response varies with certain methodological conditions at near threshold intensities but the response can usually be depended upon as nearly 100 per cent certain at definitely suprathreshold intensities.[1] This fact is in sharp contrast to the likelihood of eliciting conditioned responses in short-term conditioning studies.

Some evidence is available from studies of other response systems. In conditioned eyeblink studies, for example, 50 to 80 per cent conditioned responses on test trials might be expected after 40-50 trials well spaced in time (*21, 23*). Few estimates of this type are available for GSR conditioning, for workers have shown a preference for magnitude of response rather than number of responses as a measure.

Some audiologists have implied that they have sought 100 per cent response to tones in GSR conditioning, but none has presented detailed data on actual percentages obtained. For eyeblink audiometry the data are available. Galloway and Butler (*10*) present acquisition curves in their article. Extensive studies with GSR were conducted recently at Wisconsin (*2, 15*) with normal hearing college students. While they do not present data on maximum number of GSRs to tone alone, in 20 trials they found it necessary to test 56 students to get 40 conditionable subjects. Ten rejects were for 'difficulty in conditioning.' This difficulty was to a large extent attributed to a long interval between stimuli (CS-UCS interval of three sec.).

Further evidence comes from Stewart (*24*) who asserts: 'For purposes of this study the continuing response, as illustrated, was arbitrarily chosen as the conditioning criterion.' One is unable to ascertain for how many subjects 'continuing' means 100 per cent of the time. He does imply, however, that some subjects failed to yield perfect response and that 'their responses were erratic and little confidence could be placed in test results.' Also, 'failure to meet the criterion resulted in less than 100 per cent responses to tone while the probability of obtaining chance responses remained the same—about 20 per cent.'

In a typical conditioning situation one would expect responses to tones to become gradually more and more frequent until some maximum is reached. With adult subjects and highly controlled conditions, one of the authors (*13, 14*) has consistently

[1]This is not meant to imply that manual audiometry is 100 per cent reliable but rather that when a tone of, say, 40 db above threshold is sounded to a normal hearing subject he is 'almost certain' to raise his finger.

TABLE 1. Percentage of GSRs obtained during a series of tone-alone test trials during conditioning.

Percentage	*No. of Children*
80-89	1
70-79	1
60-69	5
50-59	4
40-49	12
30-39	10
20-29	9
10-19	4
0-9	1
N	47

obtained nearly 100 per cent response on limited numbers of test trials. However, if extinction or adaptation effects are introduced (*e.g.*, by long series of test trials without reinforcement), the percentage of responses drops to 50 per cent or below.

The rate of responding in a standard reinforcement series with severely deaf children can be roughly evaluated from Table 1, which shows the percentage of GSRs obtained on a series of test trials interspersed during 'conditioning.'

Subjects were children enrolled in the John Tracy Clinic Demonstration Preschool, a condition for admission to which is a severe auditory loss. During the course of about 18 months approximately 75 children have been included in various experimental observational conditioning groups.

The goal of these observations was very similar to that of previously published studies by Stewart (*24*) and Aronson, Hind and Irwin (*2, 15*). The main differences of importance concerned the population of subjects upon whom the observations were made. Where certain conditions were optimized in earlier studies (use of adult, normal hearing subjects), they were perhaps minimized here (use of preschool, severely deaf children).

All subjects were administered a standardized conditioning schedule beginning with six trials of 100 per cent reinforcement, then changing to 75 per cent reinforcement. In most cases a tone-shock interval of five seconds was used to permit an anticipatory response definition of conditioned responses in addition to the definition based only on GSRs during test trials (tone alone trials). For some groups, however, a .5-sec. tone-shock interval was used for comparison. With some groups the CS intensity was set at 20 db above the 'best estimate' of threshold; whereas for other groups it was consistently set at 100 db. A single frequency (500 cps) was used for most observations. During the conditioning series, test trials (tone alone) were interspersed in modified random fashion (two every eight trials) as were control trials (all equipment operated except the audiometer and shock device).

All responses meet a latency criterion (occur between one and five seconds after the tone) and a magnitude criterion (100 ohms minimum change). It can readily be seen that the results of combined groups show a low rate of responding with a median of about 40 per cent response.

Criterion of Response. Before standardization of procedure can be achieved, it is necessary to agree upon just when a GSR has occurred as a 'result' of stimulation. Such a criterion for a response is made imperative by the fact that most subjects exhibit a great deal of 'spontaneous' electrical skin activity. In order to call a resistance change a response to stimu-

lation, it has become customary to use both latency and amplitude criteria. It is important to note in passing that the previously discussed rate of responding is obviously related to or dependent upon such definitional standards.

One of the first persons to specify his objective response criteria was Stewart (*24*). He accepted only responses which possessed (a) a minimum slope of 45 degrees and (b) a minimum amplitude of five millimeters. To these was added (c) a latency criterion of not less than three or more than 13 mm on their chart paper (*7, 17*). More recently, Hind, Aronson and Irwin (*2, 15*) have explored the interrelations of latency and magnitude conditions as follows: (a) all GSRs with latencies of 1.0 to 3.5 secs. were used regardless of amplitude; or (b) all GSRs with latencies of 1.4 to 2.9 secs. were used regardless of amplitude; or (c) only GSRs of .38 or larger amplitude on a normalized conductance scale and latencies from 1.4 to 2.9 secs. were used. They found that the most strict criterion (c) eliminated all GSRs occurring at −10 db (for subjects with voluntary thresholds of zero db), yet rejected only seven per cent of GSRs occurring at +10 db.

It is evident that the problem of criteria for a response is somewhat complicated and not yet solved; yet the work that has been done has brought the problem much nearer solution and has at the same time reaffirmed the importance of such criteria to the GSR audiometric situation.

Spontaneous Response. Even the use of stringent latency and magnitude criteria for the occurrence of a response will not provide all the controls needed against other internal and external cues which may lead to GSRs at any given moment. Such 'spontaneous responding' was evaluated by Stewart (*24*), who included a number of control trials among his conditioning trials and evaluated the relative number of responses received to tone and control trials by means of a chi-square test. A control trial was 'identical to a tone presentation except that the audiometer tone interrupter was depressed and thus no tone was audible.' Because he was able to show a significant chi-square (at a significance level beyond .1 per cent) Stewart concluded that his method 'distinguishes GSRs following tone stimuli from chance responses with a high degree of certainty.' Stewart's data showed that one out of every five control trials contained a GSR response (20 per cent error).

TABLE 2. Percentage of GSRs obtained during control trials.

Percentage	*No. of Children*
60 up	2
50-59	2
40-49	0
30-39	4
20-29	5
10-19	2
0-9	10
	25

The implications of these low rates of response cited earlier can be seen by comparing them with the rate of responding for control trials on which the 'trial' sequence was run off with the audiometer set at −10 db. These data from a group of preschool age children are given in Table 2. It will be noted that a few subjects gave quite erratic responses and that the median response under these circum-

TABLE 3. Number of reinforced (tone-shock) trials required to reach a performance criterion of two successive GSRs on test (tone alone) trials.

Number of Reinforcements	*No. of Children*
40 up	6
30-39	2
20-29	6
15-19	8
10-14	10
5-9	15
	47

stances was about 20 per cent. This rate is comparable to that reported by Stewart (*24*).

In evaluating these results, it is important to emphasize several things. First, the groups of children on which they are based are not in any way restricted. That is, it has become common talk about eliminating subjects from GSR audiometry studies because they give erratic performance (*e.g.*, *15*, *24*). This was not done here. In light of such limitations it may be encouraging to see that the median per cent response to tone is twice the median per cent response on control trials.

Another way to evaluate the consistency of response is to apply some criterion of successive responding. The criterion most commonly used here is the achievement of two successive positive responses (GSRs) to tone alone trials. Table 3 shows the number of subjects requiring various numbers of reinforced trials to reach the criterion of two successive responses to tones on test trials. It will be noted that most subjects met the criterion in less than 20 reinforced trials although a few of them never reached the criterion.

Threshold Criterion. From the standpoint of audiometry, a significant decision must be made in regard to the determination of a threshold. In GSR determinations, should both ascending and descending series be used? How many times should the threshold be crossed? And what percentage of response should be demanded in designating a threshold point? Hind, Aronson and Irwin (*15*) recommended a threshold criterion between 80 per cent and 100 per cent response rather than the usual 50 per cent audiometric threshold criterion, and their reasoning is supported by data. Numerous other more or less arbitrary definitions have apparently been used. Examples are 'three responses out of five presentations for a particular intensity' (7) and 'lowest level where acceptable differential responses were obtained at least 50 per cent of the time' (*22*).

Adaptation. An interesting observation was made with one sub-group of subjects who on first testing had an adaptation series of trials to tone (100 db) alone before reinforcement by shock was introduced. Of the 25 children with such a tone-alone series, 11 children showed clear GSRs to tone (100 db) at the outset, and this response persisted for at least five trials. On the other hand, eight children gave no responses whatsoever to the tone. The remaining six children gave occasional responses but less than the rate of control responses (less than 20 per cent).

It was further observed that after the initial adaptation to tone was completed, it took a large number of trials to reinstate the response to tone by pairing with shock. The psychologist interested in conditioning might explain this as an example of the effect

of inhibition or fatigue. It clearly poses an interesting problem for the audiologist. When special adaptation trials are used in studies of conditioning, they often require a series of daily sessions, with an entire session devoted to adaptation controls. This procedure does not readily lend itself to the usual clinical audiometry situation. A tentative conclusion was made at this point that procedurally it is important to avoid adapting responses to tones during preliminary test trials if possible, using later paired trials to sustain or 'hold' the child's tendency to respond to the tone, rather than to use it to 'build up' the tendency to respond.

Other Factors. At this point it becomes apparent that the preceding enumeration of criteria leaves many important procedural matters untouched. For example, numerous different preferences exist on instrumentation (*e.g.*, whether or not to use self-returning devices, whether linear amplitude recording of the GSR is required, whether to measure resistance or potential, *etc.*). With children it becomes increasingly important to consider the activity of the child during testing, and a host of other matters which space does not permit reviewing here.

Summary and Conclusions

After examining the data presented by others and observing several samples of severely deaf children in a situation comparable to laboratory studies of conditioning, several conclusions have been reached concerning the relations of conditioning and GSR audiometry. One of the most obvious of these is that brief clinical measurement sessions preclude a complete duplication of classical conditioning procedures as used with studies of GSR by experimental psychologists. This fact leads to the awareness that many of the criteria for conditioning studies built up by psychologists and physiologists need not be invoked in the audiometric situation. They are not needed—provided adequate criteria for the audiometric situation are developed and used.

Another point of emphasis, therefore, is that a carefully formulated set of criteria needs to be developed in GSR audiometry. A historical review of the problem showed a growing awareness of these matters and an increasing volume of empirical data directed toward establishing such criteria. If one were to single out the most important requirements of the audiometric situation they would certainly include: (1) utilization of optimum conditions for sustaining the response (GSR) to sound stimuli and (2) specification of criteria to define when a response occurs to a sound stimulus. In addition, two main criteria already used involve response latency and amplitude characteristics: (3) provision for some type of objective estimate of spontaneous responses, *i.e.*, responses to nontones on control trials, and (4) specification of criteria to define the threshold. Experience has shown that this requires consideration of the criteria of response, rate of spontaneous response, and rate of responding to suprathreshold tones.

It has been concluded further that the time will soon be reached, or may already have been reached, when answers to questions regarding objective audiometry for children with hearing difficulties will not be forthcoming from studies of normal hearing adults. Equally exacting studies are needed using hearing handicapped populations, both adult and child. It is presumed that further investigations of

the factors indicated above and performed with handicapped populations may contribute to the more efficient development of the clinical evaluation procedure. It is particularly evident from the data presented here that the purpose of the conditioning trials (trials pairing sound and shock) is to *sustain* the response to sound, not necessarily to establish it initially. Therefore, all considerations of 'traditional' conditioning procedures which work against this goal should be avoided. These include any conditions which might adapt or reduce the child's initial tendency to respond to sounds with a GSR.

Finally, certain conclusions have been reached concerning the essential differences between GSR audiometry as a clinical tool and as an objective research area. The above discussion has rested upon the assumption that 'objective audiometry' as a diagnostic tool could be improved by careful scientific study. It is often stated that GSR audiometry is an 'art' incapable of standardization, that the individual case determines the kind of procedure to be used and the criteria for threshold estimation.

It is indeed true, from the data obtained from severely deaf children, that the gap between the clinical and research use of GSR audiometry is a wide one. It is proposed, however, that this remains simply a case of the familiar problem of validating diagnostic instruments on the individual case and that if the GSR and other related procedures are to prove their worth, they must combine the benefits of acute clinical perceptiveness and systematic, objective tests of basic issues. Both will be aided by further development of well formulated theory and observational methodology.

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Speech Error Recognition Ability

Herbert J. Oyer

Numerous writers have commented upon the efficacy of certain procedures which are employed in school systems to locate persons in need of speech rehabilitation. Suydam (*4*) states that there are four principal methods employed by speech clinicians for locating those youngsters in need of speech training. They are the (1) referral method, (2) speech survey, (3) combination of referral and survey and (4) voluntary enrollment. On surveying public school correctionists in eight states in the Middle West, she discovered that 75 per cent of the correctionists were employing the survey method either alone or in conjunction with teacher referrals. Only 24 per cent of those replying to her questionnaire indicated that they relied completely upon teacher referral of cases.

Ainsworth (*1*) believes that a disadvantage of the referral method is in the added burden placed on the classroom teacher at the outset of the school year. He states that this method results in saving of time but cautions that the classroom teachers should have prior instruction by the clinician in order that teachers may learn which children are in need of referral. He suggests that clinicians need not feel committed to any one procedure but that a combination of survey and referral might well be employed.

Edney (*3*), in a discussion of current methods which are employed to find youngsters in need of speech and hearing therapy, concludes that the survey approach is probably the most thorough procedure the clinician can use but states that referral is utilized quite often in schools. Parents, nurses and school psychologists as well as the classroom teachers can function as referral sources. He asserts, however, that the effectiveness of the referral method is a function of the degree to which the referral source is aware of speech deviations. He emphasizes also the importance of an in-service training session for teachers preceding the request for referral of children.

Irwin (*2*) recommends that a survey of a school population should continue throughout the school year until the therapist has completely surveyed his area. In following years, the therapist tests entering first grade pupils, transfer pupils, referrals, and those children who have previously been enrolled in the speech therapy classes or are yet on a waiting list. It appears that referral is looked upon as a method with some merit but as sort of a 'second-best' to the individual interview of children that takes place in the comprehensive survey.

An a priori assumption relative to speech error recognition might well be that training in speech and hearing therapy equips the clinician to do a much more effective job of selecting children than can be done by class-

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room teachers. If it does, then great effort should be put forth by the clinician to survey personally the school population to which he is assigned. If, however, the classroom teacher is as effective as the speech therapist in this task, then it would appear that it would be far more economical to rely on teacher referral.

Purpose

It was the purpose of this study to assess speech error recognition ability of two groups of college seniors. One group was composed of 20 seniors majoring in speech and hearing therapy. The other group was composed of 20 seniors majoring in elementary education. The elementary education group had had one course in speech problems.

The null hypothesis under test was as follows: There is no significant difference in speech error recognition ability between seniors in elementary education and seniors in speech and hearing therapy.

Procedure

Subjects. The speakers participating in the study were six boys and four girls with articulatory defects who were currently enrolled in a public school speech therapy class. The children ranged from grades four through six. They were selected by their speech therapist as exemplifying typical articulation problems found in the elementary school.

Judges. Two groups of students, 20 seniors in elementary education and 20 seniors majoring in speech and hearing therapy served as the listeners. They made judgments with reference to the accuracy of production of certain consonant sounds used in selected words spoken by the children. A sweep-check audiometric test at frequencies 256 cps through 8192 cps was given each student judge. Thresholds were at 15 db or better in each ear tested. Testing was accomplished with a Maico (D-9) Audiometer in a sound treated room.

Three college instructors in the area of speech and hearing served as the criterion judges in order to make possible the construction of a scoring standard.

Recording. The recorder employed was a Revere (500). Tape speed was 7½ inches per second. Responses were elicited from the children by showing them pictures. Words uttered contained the following sounds:

1. [p], [b], [t], [d], [n], [k], [g], [s], [z], [f], [v], [l], [r], [ʃ], [tʃ], [dʒ] and [θ] in initial, medial and final positions.
2. [i], [hw] in initial position.
3. [w] in initial and medial positions.
4. [ŋ] in medial and final positions.
5. [ð], [ʒ] in medial position.

The lips of speakers were held at six inches from the microphone. The experimenter employed a stop watch in order to hold the time interval between utterances constant at three seconds.

Words Employed. The following words were elicited from the children as a result of visual stimulation with pictures and the request, 'Tell me what you see.'

*p*ie — ty*p*ewriter — soa*p*
*b*aby — straw*b*erries — bath tu*b*
*m*an — snow*m*an — gu*m*
*t*omato — valen*t*ine — shir*t*
*d*og — ra*d*io — brea*d*
*k*nife — pe*nn*y — spoo*n*
*c*at — coo*k*ies — cloc*k*

*v*iolin — sho*v*el — sto*v*e
*th*read — too*th*brush — tee*th*
*l*ion — watermelo*n* — be*ll*

TABLE 1. Mean error scores and *t* score for elementary education and speech and hearing therapy groups.

Groups	*Means*	*t*
Elementary Education	33.1	.759*
Speech and Hearing Therapy	35.5	

*At 38 df—not significant at .05% level.

red — typewri*t*er — ca*r*
yellow — *w*atch — flo*w*ers
ring — tele*v*ision — fea*th*er
*wh*eel

girl — wagon — flag
Santa Claus — pen*c*il — house
*sh*oe — wa*sh*ing machine — fi*sh*
*ch*air — peaches — wat*ch*
zebra — scissors — pea*s*
giraffe — sol*d*ier — orange
fi*sh* — ele*ph*ant — knife

Playback. Stimulus units were played back on the Revere (500) in a classroom. Listeners were seated in a semicircle equidistant from the sound source.

Rating Sheet. The rating sheet contained a total of 610 responses, as each of the 10 speakers uttered 61.

Instructions to Judges. The directions given to listeners were as follows:

> You are about to hear words spoken by elementary school children. The responses are printed below in the order in which they are spoken. Be particularly careful to listen for the sounds that are underlined in the words. If they are not produced acceptably (omitted, distorted, substituted), draw a line through the entire word.
>
> Example: *b*all (pause), ba*b*y (pause), tu*b* (pause). If the [b] sound is not produced acceptably in the word *ball* you would indicate it in this way: *b*all. Do the same with the other words if the sound is not acceptable. Remember, you are to draw a line through the word only if the underlined sound is not acceptable.

TABLE 2. Mean error scores and *t* score for elementary education and speech and hearing therapy groups.

Groups	*Means*	*t*
Elementary Education	21.6	.304*
Speech and Hearing Therapy	25.5.	

*At 38 df—not significant at .05% level.

Analysis of Data and Results

Analysis of error scores was made in relation to (1) complete agreement and (2) two out of three agreement among criterion judges. A *t* for nonrelated measures was employed to determine whether significant differences existed between the mean error scores of the two groups being compared. In Table 1 are presented the mean error scores and *t* score for the elementary education and speech and hearing therapy groups. These scores were computed on the basis of two out of three agreement among criterion judges. In Table 2 are presented the mean error scores and *t* score for the elementary education and speech and hearing therapy groups. These scores were computed on the basis of complete agreement among criterion judges.

Summary and Conclusion

Two groups of listeners, 20 speech and hearing therapy majors and 20 elementary education majors made judgments as to the accuracy of production of specified consonants as they were uttered in words spoken by 10 elementary school children. The speech of the children was characterized by defective articulation. Error scores of the two groups were computed on the basis of (1) com-

plete agreement and (2) two out of three agreement of criterion judges. In both instances the *t* scores obtained were not significant at the .05% level.

On the basis of the data obtained within the experimental confines of this study, it is impossible to reject the null hypothesis set forth at the outset, *i.e.*, 'There is no significant difference in speech error recognition ability between seniors in elementary education and seniors in speech and hearing therapy.' Assuming that the relative skills of each group remained in the same proportion, it could be inferred that elementary teachers might well operate as successfully in selecting the speech and hearing case load as the public school speech and hearing therapist. The outcomes of the study might have been somewhat different, however, if the subject population had been partially comprised of some non-defective speakers instead of all defective ones.

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Effectiveness Of Trained Parents As Speech Therapists

LaRene C. Tufts

Audrey R. Holliday

The ability to communicate through the medium of comprehensible speech is widely recognized as a necessity for adequate functioning on the part of an individual in relation to his environment. School systems throughout the country have explicitly recognized this by employing large numbers of professional speech therapists to work with the speech problems presented by children in the elementary grades. Functional articulation problems comprise a large part of the therapists' case loads. Roe and Milisen (*8*), for example, found a mean of 13.80 articulation errors per child in the population of first grade children they examined.

Since children with speech defects do feel some degree of social stigma, and since a large proportion of the heavily burdened speech therapist's time is taken up dealing directly with articulation problems presented by children in the early elementary grades, it seems clear that such problems ought to be alleviated prior to the child's entrance into school whenever possible. In fact, many university speech clinics do draw a large proportion of their cases from this preschool group.

It is the thesis of this study that speech therapists might function more effectively if they trained parents of preschool children to correct the functional articulation errors of moderate severity exhibited by their children rather than attempting to work with each child after his entrance into school.

The case loads of public school speech therapists are far too heavy. For example, the 1956 report of the Chicago schools (*4*) indicated that each speech therapist was seeing approximately 125 children a week.

Many distinguished professional people working with exceptional children are of the opinion that parent aid in the training of these children is helpful and that it is possible to train parents to perform certain types of therapy (*5, 6, 9, 11, 12*). To this time, most such efforts have been applied where the children have defects of organic, rather than functional, origin. There would appear to be no reason why parent training should not be extended to the functional articulatory problems.

It was the purpose of this study to test experimentally the predictions that (1) parents of preschool children with articulation problems can be

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trained over a short period of time to help their children effectively with those problems and (2) that speech training of preschool children by either trained parents or a professional speech therapist will result in a significant reduction in articulation errors when the speech of these children is compared to the speech of children who have had no formal speech training of any kind.

Subjects

All of the children used in this study were siblings of children in attendance in the public schools in a Washington city. The subjects were obtained by sending a request through regular school channels. The parents were asked to respond only if they had a preschool child with an articulatory difficulty who was at least four years old but less than six years old. One hundred and thirty-five possible subjects were obtained in this manner. It had been decided prior to initiating the study that only preschool children between the ages of four and six who were of normal hearing, who were of average intelligence, who showed adequate functioning of the peripheral speech mechanism, and who were judged to have a functional articulatory defect of moderate severity would be utilized.

Of the 135 children, 51 were not included in the study because an audiometric examination showed them to have a reduction in hearing acuity of at least 10 db in one or more frequencies between 125 cps and 8000 cps. Nine of the children were not included in the study because they exhibited some reasonably severe type of abnormality of the peripheral speech mechanism. Seventeen children were not included because their scores on the Full-Range Vocabulary Test, Form A, (*1*) indicated I.Q.'s outside the specified limits of 90 to 110.

TABLE 1. The mean age and I.Q. of the 10 children comprising each group.

Group	*Mean Age*	*Mean I.Q.*
A (Maturation)	5.05	101.3
B (Therapy)	4.95	100.8
C (Parents)	4.95	101.5

The degree of articulatory difficulty was assessed for each of the remaining children with a phonetic inventory and five-point rating scale as measuring instruments. A Rank of 1 on the rating scale indicated unintelligible speech. A Rank of 5 indicated no dysfunction in articulation. All children who received Ranks of either 1 or 5 were not included in the study. Fifteen children were eliminated because they received Ranks of either 1 or 5.

Forty-three preschool children who met the criteria of normal hearing, average intelligence, normally functioning peripheral speech mechanism, and a functional articulatory defect of moderate severity were, then, available for study.

Three groups, hereafter referred to as A, B and C, were selected for participation in the investigation. The 10 children comprising each group were randomly assigned from the total of 43 preschool children who met the criterion for the study, and the method to be applied to each group was randomly assigned. Group A became the Maturation Method (no speech training) Group. Group B became the Speech Therapist Method (speech correction procedures taught by a trained speech therapist) Group. Group C became the Parent Therapist Method (speech correction pro-

cedures taught by the parents) Group. Table 1 shows the mean age and mean intelligence quotient of the 10 children comprising each group. The three random, independent groups were very homogeneous in regard to these variables.

Procedures

General. Prior to any experimental manipulation, each of the 30 children selected for participation in the study was presented to each of three judges for an evaluation of the degree of severity of the functional articulatory defect present (Trial I). The judges were not aware of the method group to which any child had been randomly assigned. Each judge rated each child on the same five-point rating scale as had been used in the initial selection. The judges were unaware that all of the children whom they were rating had previously been scaled as falling between Ranks 2 and 4 by the investigator. No judge scaled any child as falling at Rank 1 or Rank 5. The judges made their independent rankings of the children on the basis of the child's verbal responses to pictures and to direct questions and on the basis of listening to his spontaneous connected speech.

At the conclusion of the application of the experimental techniques, the judges re-ranked the children in all three groups on the same scale (Trial II). Again, the judges did not know to which group any child had been assigned.

Method for Group A (Maturation). The parents of these 10 children were instructed apropos the purpose of the study and were asked to do nothing about their children's speech problems for the following seven months, the time during which the study was conducted. They were informed that following the study they would be given instructions in regard to what they might do to help their children with their speech problems. Neither the children in this group nor their mothers had any further contact with the speech therapist during the time of the investigation.

Method for Group B (Speech Therapist). The 10 children in this group met with the speech therapist for a half-hour twice each week during the seven months of the study. Holidays were excluded; there were 46 sessions.

Routine speech therapy was used with these children. In the instances where a sound was in error for all the children concerned, the whole group worked on the same sound. Where different children had different sound errors, each child would work on his own sound, the whole group using the same method. As an example, the whole group might be working on sound discrimination, but Subject 1 would work on the [f] sound when it was his turn and Subject 2 would work on the [k] sound when it was his turn.

The children played numerous sound games, and no formal drill, as such, was used. There was a great deal of social interaction within the group as suggested by Beasley (*2*). Introduction of each sound was followed by sound discrimination in isolation, in nonsense syllables, in words and in connected speech; after this, the children attempted to produce the sound. During the sound-production phase, the placement of the articulators was taught, followed by production of the sound in nonsense syllables, in isolated words, and, lastly, in connected speech.

Method for Group C (Parent Therapists). The 10 mothers who comprised the parents' group met for an

TABLE 2. Mean ranks assigned by three judges for each child in three method groups.

Subjects	Method A		Method B		Method C	
	Trial I	Trial II	Trial I	Trial II	Trial I	Trial II
1	3.00	3.00	3.00	4.00	3.33	4.00
2	2.67	2.33	3.00	4.00	2.67	3.67
3	2.33	2.33	4.00	5.00	3.33	4.00
4	3.33	3.00	3.67	4.00	2.00	3.00
5	3.00	3.00	2.67	3.67	3.33	4.67
6	3.00	3.00	3.67	5.00	3.33	4.00
7	2.00	2.00	2.67	3.33	2.67	3.33
8	2.67	2.67	2.67	2.67	2.67	4.00
9	3.00	3.00	2.00	3.00	2.67	5.00
10	2.00	2.00	4.00	4.67	3.33	4.00
Total	27.00	26.33	31.35	39.34	29.33	39.67

hour once each week for seven months. Four holidays fell during this period; there were 25 sessions. The children in this group were not seen by the speech therapist at any time during the study. None of the mothers of the children in Method Group C held college degrees and two had not finished the last year of high school. These mothers were no more 'educated' than would be the mothers with whom most public school speech therapists come in contact.

Each session with the therapist was divided into two parts. The first half-hour of each meeting was spent instructing the parents in the fundamentals of correcting articulatory problems. During this time, they were instructed in the phonetic bases of sounds and how these sounds changed when used in connected speech, in the articulatory placement of each sound, techniques of ear training, techniques of individual sound placement, and how building the proper use of a sound might progress through the use of nonsense syllables, single words and connected speech. Proper methods in reference to the foregoing were also taught these parents.

Further information was made available to each mother by giving her a copy of the pamphlet *Learning to Speak Correctly* (*3*). *Talking Time* (*9*) was also made available to this group of mothers.

During the last half-hour of each period, group discussion techniques were utilized, with the parents discussing such problems as their children's speech problems, sibling rivalry, behavior problems, home environment problems, and individual problems they had which they thought affected their children directly or indirectly. The therapist did not attempt to solve these problems for the parents but acted here as a nondirective group leader.

Results

Table 2 shows the mean ranks obtained by each child in each group before and after the described experi-

TABLE 3. Analysis of variance for differences between groups on Trial I.

Source of Variation	df	Mean Square	F
Between groups	2	.470	1.62*
Within groups	27	.292	

*With 2 and 27 *df* an *F* of 3.35 would be necessary for significance at the 5% point.

TABLE 4. Analysis of variance of performance scores of three groups of subjects tested under different methods with two trials for each group.

Source of Variation	*df*	*Mean Square*	*F*
Between methods: A, B, C	2	4.580	7.63*
Between subjects in same group	27	.600	
Between trials: I, II	1	5.190	67.40†
Interaction: trials x methods	2	1.680	21.82*
Interaction: pooled subjects x trials	27	.077	

*With 2 and 27 *df* an *F* of 5.49 is significant at the 1% point.

†With 1 and 27 *df* an *F* of 7.68 is significant at the 1% point.

mental manipulations were applied.

Table 3 shows a summary of the analysis of variance for the three independent groups, A, B and C on Trial I. Trial I represents the mean judgment or score for each child in each group prior to any experimental manipulation. The obtained *F* of 1.62 is not significant. There is no significant difference among the three groups on Trial I; they appear to be homogeneous samples from the same population.

Table 4 shows a summary of the analysis of variance for the two measures on each of the three groups. The *F* of 67.40 for the between trials, I and II, is significant ($P < .01$). There is a very significant difference between Trials I and II in the direction of improved speech on Trial II.

With two and 27 degrees of freedom, the *F* of 7.63 between methods is significant ($P < .01$). There is a very significant difference between the methods.

The *F* of 21.82 for the interaction between trials and methods is significant ($P < .01$). This indicates that the observed improvement between trials depends on which method is being considered. It implies that all three methods did not result in improved speech. The independent *t* between the degree of improvement for Groups B and C yielded a nonsignificant, independent *t* of 1.124. The null hypothesis of no difference between Groups B and C in regard to the degree of improvement between Trials I and II is tenable. An examination of Table 2 showing the raw mean scores for all subjects indicates that there is essentially no change between Trials I and II for Method A. Both Methods B and C resulted in an equally large improvement between Trials I and II. The very significant difference between trials is due to the improvement in speech shown by the children in Methods Groups B and C. The significant difference between methods is between Method A and the other two methods.

Discussion

The results of this study give experimental support to the contention that parents of preschool children with articulation errors can be trained over a short period of time to help their children effectively with these problems. The hypothesis that speech training of preschool children by either trained parents or a professional speech therapist will result in a significant reduction in articulation errors when the speech of these children is compared to the speech of children who have had no formal speech training of any kind is verified.

For the group in which the parents taught their own children, the results are not significantly different from those in which the professional speech

therapist trained the children. This indicates that parents can be adequate teachers for their own children who have moderate articulation problems. Parents who understand the process and methods of functional articulation therapy can correct the functional articulation errors of moderate severity exhibited by their preschool children to the same degree to which a trained speech therapist is able. The mothers of the children in method Group C were able to utilize the speech correction methods they were taught and to profit from the nondirective group experience in a most effective way.

The lack of improvement in the maturation group between Trials I and II does not imply that maturation does not alleviate many sound errors which might be present in the speech of young children. However, it does show that over a period of seven months the maturation factor did not play a role in speech improvement for children in the age range of four to six years. The fact that both therapy groups improved very significantly shows that training for the amelioration of functional articulation problems is beneficial at this age level. Some of the children in the therapy groups improved to the point where their speech was rated as 'perfect' by the judges at the end of the study.

The results of this study strongly suggest that speech therapists ought to consider carefully the possibility that a proportion of their time might most profitably be spent training parents to work with the functional articulation defects of moderate severity exhibited by preschool children. More children would be reached; eventually, fewer children would enter school with the necessity of being admitted to a speech correction program; speech therapists would have more time to devote to more serious and/or refractory speech problems. Last, but certainly not least, many children with ineffective speech might be prevented the destructive experience of attempting to compete with, and relate to, their normally speaking peers in the school environment.

Those speech therapists untrained in techniques of group discussion who could not ethically lead the kind of group discussion afforded the mothers in this study might ally themselves with a clinical psychologist or psychiatrist who was so trained. The speech therapist might then demonstrate techniques of speech correction, allowing the psychologist or psychiatrist to work with the mothers in their exploration of their relationships with their children. The shifts in attitude the mothers in this study showed as a consequence of their nondirective group sessions probably played a role in making them effective teachers. A further study designed to assess the degree to which the nondirective group sessions contributed to making the mothers effective speech correctionists is in progress.

Summary

Three groups of 10 children each were randomly selected from a population of 43 children who were between the ages of four and six and who had normal hearing, average intelligence, and adequately functional articulation defect of moderate severity. A random assignment of a training method was then made for the three groups. The Maturation Method Group received no speech therapy between ratings. The Speech Therapist Method Group had speech therapy as a group administered by a trained speech therapist using routine articulation therapy. The Parent

Therapist Method Group was composed of 10 mothers who received instruction in methods of handling articulation therapy for their children. Each mother worked with her own child during the seven-months period of the study. Three professional speech therapists acted as judges and rated each child before and after the study on a five-point rating scale.

There was no significant improvement from Trial I to Trial II for the Maturation Group. The Speech Therapist Group and the Parent Therapist Group both showed very significant improvement. No significant difference in the degree of improvement was found between these two groups. The significant difference between groups was accounted for by the lack of improvement in the Maturation Group as compared to the other two groups.

The implications of this study are that the speech of preschool children with moderate functional articulatory difficulties can be improved by their mothers if these mothers are trained by a professional speech therapist. It is suggested that speech therapists might put a proportion of their time to very profitable use by training mothers to correct their own children's speech.

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Limitations Of Selected Frequency Audiometry In The Public Schools

Maurice H. Miller

Jeanne L. Bella

'A new concept in auditory screening' has recently been introduced for use in screen testing the hearing of large populations. In this method of screening, only the 4000-cycle frequency or the 2000- and 4000-cycle frequencies are tested. Proponents of this method have presented audiometric evidence on several populations which they believe makes it possible to predict that losses at any standard test frequency will not be more than the loss at 4000 cps. Both a one- and a two-frequency version of the instrument, known as the Oto-chek, are now commercially available.

Glorig and House (*1*), who have suggested this approach to auditory screening, tested 1500 school children at 4000 cycles only and then by the standard, five-frequency sweep-check method (500-8000 cps). Ninety-four and four-tenths per cent of the children passed the single-frequency test, while 93.3 per cent passed with the sweep-check method. These authors conclude that single-frequency testing at the 4000-cycle frequency is 98.5 per cent as accurate as the sweep-check test.

To evaluate the efficiency of the single-frequency screen test method, it is necessary to compute the percentage of children who *fail*—not pass—with each method of screening. It is the group of children *with* hearing loss which must concern us in an adequate program of hearing conservation, not the larger group of children with normal hearing. When the Glorig-House data are thus analyzed, we find that of the 1500 children tested, 84 children failed the single-frequency test while 101 children failed the five-frequency sweep-check. This means that the five-frequency sweep-check picked up 17 more children with hearing loss than did the single-frequency test. Seventeen children represent almost 17 per cent of the total number of children with hearing loss. It appeared to the present authors that any proposed screening method which misses this percentage of children with hearing loss should be carefully evaluated. They are indebted to Dr. David Green (*2*) of the Jefferson Hospital in Philadelphia, Pennsylvania, who suggested the importance of computing the percentage of children who failed by each method.

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Audiometric Data

In an effort to evaluate the efficiency of single- and double-frequency testing in the school system, we have analyzed the results of pure-tone audiometric screening tests performed in a one-year period in the public schools of Greenwich, Connecticut. These tests constitute the 1956-57 school year's audiometric testing program conducted by the Public Health Nursing Service of Greenwich, Connecticut, in cooperation with the Board of Education of Greenwich and the administrations of four local parochial schools. All tests were performed with one ADC Model 53C Pure-Tone Audiometer by one of the authors who had had five years' previous experience testing in the school system. Before the testing began in September 1956, the audiometer was calibrated with an Allison artificial ear. The testing program was completed in March 1957.

The group of children selected to participate in the program comprises about one-third of the total school population each year and is classified as follows:

A. *Routine screening* at the 15-db level
   1. Grades 1, 4, 9 and 12
   2. All students newly registered in the school system since the preceding year's testing was completed (except those in kindergarten).
   3. All students referred for testing by physicians, school nurses, teachers or parents. Specifically included in this group are all children who have had a tonsillectomy, adenoidectomy or communicable disease within the past year and children receiving speech and hearing therapy.

B. *Follow-up testing* also using the 15-db level. All students previously tested in all other grades who showed a loss of 25 db or more at one or more of the frequencies tested.

All students were tested individually at the following 10 frequencies: 125, 250, 500, 1000, 2000, 3000, 4000, 6000, 8000 and 12000 cps, with each tone presented in 'spurts' at irregular intervals. Any student who did not respond to each of the tones at the 15-db level was retested not less than five weeks after the first test. The results of the second test were used to determine the need, if any, for otological referral.

Noise levels were comparatively low while the testing was being conducted. A quiet room or closet was found in each of the 12 elementary schools, one junior high school and two senior high schools. The audiometrist did not have a sound level meter available and the level of ambient room noise had to be judged subjectively. Testing was halted whenever evidence of difficulty in hearing the lower frequencies became apparent. The audiometrist checked her own thresholds with the audiometer periodically. The earphones were always immediately readjusted by the tester whenever a student failed to hear a tone at the 15-db level. This precaution is particularly important in testing at 8000 cps where standing wave patterns may interfere with the accurate determination of threshold. There were no outbreaks of communicable diseases during the year. The audiometer performed well from beginning to end. The audiometrist had no knowledge of the Oto-chek or the rationale for its use before the close of this testing program.

TABLE 1. Incidence of hearing loss in population tested. Criterion for hearing loss: a loss of 20 db or more at one or more frequencies. Range of frequencies tested: 500, 1000, 2000, 4000 and 8000 cps.

	Total Hearing Impairments		*Total Population Tested*
	Excluding Losses at 8000 cps	*Including Losses at 8000 cps*	
N	233	429	3630
%	6.4	11.8	100

The criterion for hearing loss used in the present analysis was a loss of at least 20 db or more at one or more of the following frequencies: 500, 1000, 2000, 4000 and 8000 cps. These frequencies were selected because they represent the same range which was used in the five-frequency sweep test of 1500 school children reported by Glorig and House. Table 1 shows the number of children in the population tested who were found to have losses of hearing. Of the 3630 children screened, 429 losses, or 11.8 per cent of the total population tested, were detected by a five-frequency screen test according to the criterion stated. It was found that 196, or 5.4 per cent, of these losses occurred at 8000 cps only, which means that in 233 or 6.4 per cent of the losses the four lower frequencies were involved. The significance of losses of hearing in children restricted to 8000 cps and above is not generally accepted by workers in the field (*3*). We have, therefore, stated our results in two ways: (1) percentages of hearing losses found when 8000 cps is included in the analysis and (2) percentages when 8000 cps is not included.

Frequency of Greatest Loss

Glorig and House conclude, on the basis of their audiometric analyses,

TABLE 2. Audiometric frequencies of most severe loss expressed in percentage and number of losses. Five hundred, 1000, 2000 and 4000 cps only were used for this portion of the study.

Frequency in cps	*Total Losses (233)*		*Per Cent of Total Population (3630)*
	N	%	
Below			
2000	66	28	1.8
4000	124	53.2	3.4
At			
500	9	3.9	
1000	50	21.5	
500, 1000	7	3	
2000	48	21	
1000, 2000	7	3	
500, 1000, 2000	2	.9	
500, 2000	1	.43	

TABLE 3. Efficiency of 2000 and 4000 cps in detection of hearing loss expressed in percentage and number of losses which would have been missed.

	2000 cps and 4000 cps including losses at 8000 cps only	*2000 cps and 4000 cps excluding losses at 8000 cps only*	*4000 cps with loss at 2000 cps*
Re: total losses	53.8% (321)	8.2% (35)	7.2% (31)
Re: total population	6.4%	.96%	.85%

that one can quite accurately predict that losses at any standard test frequency will not be more than the loss at 4000 cps. Audiometric data of the present study were analyzed to determine whether the observation holds true for the population tested. This analysis is shown in Table 2.

The authors consider losses of hearing in the high frequencies to be of considerable medical significance when they are obstructive in nature. In their experience, otological examination of children with losses of this type frequently reveals slight but significant pathology, especially excessive lymphoid tissue around the nasopharyngeal orifice of the Eustachian tube. High frequency losses of the conductive type can be differentiated from static, nonprogressive high frequency losses by bone-conduction testing at the high frequencies, Weber-and-Rinne testing with the bone-conduction oscillator of the audiometer at the involved frequencies, and recruitment tests. All children found to have such high frequency losses of hearing are routinely referred for otological examination.

Excluding losses at 8000 cps only, it was found that 66, or 28 per cent, of the losses were most severe *below* 2000 cps and that a total of 124 losses, or 53.2 per cent, were most severe *below* 4000 cps. These data indicate that in over half of the losses found at 500, 1000, 2000 and 4000 cps, the point of greatest loss was not 4000 cycles. The authors are unable to accept the conclusion that it is possible to predict that a loss at any standard frequency will not be more than the loss at 4000 cps.

Selected Frequency Audiometry

The data were examined to determine how efficiently the one- and two-frequency Oto-chek would have operated in this population. The results of this analysis are shown in Table 3. If the 4000 cps Oto-chek had

TABLE 4. Efficiency of different frequency combinations expressed in percentage and number of losses which would be missed.

	Frequency Combinations in cps							
	500, 4000		*1000, 4000*		*500, 1000, 4000*		*1000, 2000, 4000*	
	N	%	*N*	%	*N*	%	*N*	%
Re: total losses	29	12.4	22	9.4	14	6	7	3
Re: total population		.8		.61		.39		.19

been used, only 167, or 39 per cent, of our 429 losses would have been detected. If the losses which occurred at 8000 cps only were excluded from the calculations, 72 per cent of the remaining 233 losses would have been detected.

The authors evaluated the two-frequency Oto-chek which includes the 2000-cps in addition to the 4000-cps tone. Had the two-frequency Oto-chek been employed, an additional 31, or 7.2 per cent of the 429 losses, would have been picked up. Excluding the losses at 8000 cps only, however, 85 per cent of the losses at the four lower frequencies would have been detected.

It is essential to consider the number of hearing losses which would not have been detected by either a one- or two-frequency Oto-chek. Thirty-five losses or 8.2 per cent of the total number found which occurred below 2000 cps only would not have been detected by either version of the Oto-chek. Thirty-one losses, or 7.2 per cent of the total number found, showed an impairment at 2000 cps but were normal at 4000 cps. This group, in addition to the losses below 2000 cps only, would have been missed if the 4000 cps Oto-chek had been used. It does not seem advisable to recommend the use of an instrument which would miss 66, or 15 per cent, of the losses at the 500, 1000, 2000 and 4000 cps frequencies. This would be the case if the 2000 and 4000 cps Oto-chek had been used for these tests.

The data were then analyzed to determine possible frequency combinations which might be utilized more efficiently for rapid screen testing than 2000 and 4000 cps. These results are shown in Table 4. No one frequency was found to be adequate for this purpose. Of the two-frequency combinations tried, 1000 and 4000 cps resulted in missing the fewest number of hearing impairments: 22 losses, or 9.4 per cent of the 233 losses at 500, 1000, 2000 and 4000 cps. The best three-frequency combination is 1000, 2000 and 4000 cps. When these frequencies are used, three per cent of the losses at the four lower frequencies were missed. However, the difference between the time it takes to test three frequencies and the time required for all five frequencies is relatively small. The time and effort involved in preparing the child for the test and in placing and removing the earphones is the same for a three- or a five-frequency sweep check. While we find that a three-frequency Oto-chek utilizing the 1000, 2000 and 4000 cps frequencies is almost as efficient as the full five-frequency test, the amount of actual time saved in testing is probably negligible.

Conclusion

The present authors are fully in accord with the use of the Oto-chek in industrial situations to determine which workers are in danger of suffering handicapping losses of hearing from the effects of continued exposure to intense noise. However, in regard to the use of the Oto-chek for screen testing the hearing of school children, our analysis of the 3630 tests performed in the Greenwich school system in a one-year period forces us to reach the following conclusions:

1. The audiometric frequency showing the greatest loss is not at 4000 cps in a large portion of the losses found in the population tested.

2. Screen testing limited to the 2000 and 4000 cps frequencies will fail to detect a significant number of children with losses of hearing.

3. A three-frequency test including 1000, 2000 and 4000 cps is almost

as efficient as the complete five-frequency sweep check, but the amount of time saved is probably negligible.

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Clinical Notes

Esther L. Herbert, *Editor*

Adult Education Program for Mothers of Children with Speech Handicaps

In the fall of 1956, the University of Pittsburgh offered, through its non-credit adult education program, a course for parents entitled 'Your Child's Speech Problems.' Twelve mothers participated in the eight two-hour sessions. The income to the University was negligible—not even sufficient to pay the instructor's salary. However, the results of the course, as measured by the behavior of its students, would suggest that the University had achieved one of its primary goals for its adult education program —service through educational procedures.

'Your Child's Speech Problems' was designed to give the mothers enrolled some general background information in speech development and in child development, to help them understand the concept of the 'normal,' to give them some brief introduction into the etiologies of speech disorders, to acquaint them with professional services available to children with communication handicaps, and to make them aware of their own roles in the total process of speech development. These mothers were free to discuss any problem within the group and to ask the instructor any questions they wished. They were made aware from the first session that no course dealing in general principles could attempt to offer solutions to specific problems in children who had not been evaluated clinically. These mothers were able to develop good understanding of the instructor's attitude without sacrifice to group spontaneity, interest, or productive thinking.

Attendance throughout the eight sessions was excellent, and each class session had to be terminated by the instructor usually from 15 minutes to a half-hour after the scheduled time. These mothers were often reluctant to leave the classroom even then and would frequently engage the instructor in individual conversations before their departure. In short, they appeared to be an enthusiastic group. These mothers were seeking help for their children but had been unable to find it through the usual channels either because they did not know of these resources or this type of contact constituted far too great a threat. They were able, however, to accept the kind of assistance that could be obtained by 'taking a course,' the content of which could be interpreted impersonally.

Since this program was an experiment in adult education as well as in parent education and guidance, it seems appropriate to evaluate the results in terms of the parents who enrolled, the influence of the instructional materials and discussions upon

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subsequent action, and the disorders presented by the children. Perhaps we can best undertake the three-fold evaluational process by discussing each mother individually and then drawing conclusions from the group as a whole.

One of the 12 mothers selected this course because she wanted to involve herself in adult education, and this offering came at a time convenient to her. She was both a mother and a grandmother but had no current personal reason for her interest. Three of the mothers had children with very mild disorders of consonant articulation about which they wanted information but did not consider sufficiently serious to warrant a clinical contact. Another came to seek aid for a child so severely mentally retarded that he was excluded from many services. Still another enrolled after she had inquired about the course content during an interview in the speech clinic. She had three children with voice and articulation problems of a complex nature. It is interesting to note that she had already sought clinical help prior to entering the course, and she was the only mother who actually dropped out before its conclusion. The reasons given were difficult work schedules and illness. Recognizing that it is dangerous to generalize from a single case, we cannot but wonder whether this course held any real interest for a parent who recognized problems in her children and who had already sought professional help with them.

The remaining six mothers, all of whose children presented severe disorders of communication, eventually requested clinic appointments. Of these, one had a daughter of seven who had gone undiagnosed because of parental fear. Following the course and resultant study in the clinic, the child was seen by a neurologist and the diagnosis of brain injury with emotional overlay was made. The parents were referred for psychiatric help.

A second mother in this group had a four-year-old daughter with multiple speech problems involving consonant articultaion and stuttering, behavioral disorders, and emotional disturbance. The family physician eventually placed the child on sedatives and the parents under his guidance.

Another mother had a little girl with severe consonant problems which responded slowly to therapy. The mother herself had strong guilt feelings which she had been unable to resolve and for which she sought help in a guidance center. Prior to the parents' course, she had been too frightened to seek help for her child.

A fourth mother also had a little girl with a consonant deficit which rendered her speech unintelligible. This mother sought psychiatric help independently at the conclusion of the course. The child made excellent progress in treatment.

The fifth mother brought to the clinic a three-year-old daughter with brain damage and severe emotional disturbance. It was the concensus that psychiatric aid was indicated for both the parents and the child. This recommendation was accepted and acted upon by the parents.

The sixth mother did not seek help until one year after the start of the course. She presented a severely retarded child with little or no speech and a history which included a second mentally retarded child who had died in an institution. She herself was a young woman who saw nothing but trouble ahead. After the discussion in the clinic, she decided to look into the possibility of psychiatric aid for herself as a means of learning to han-

dle her life situation more effectively.

When we analyze the mothers who comprised this group, we see that all but one had children with speech problems. Of the 11 mothers whose children were experiencing trouble acquiring speech adequacy, three reported minor problems which they were interested in handling wisely and understanding more completely. One accepted the diagnosis of mental retardation in her child but thought she might help him to develop a little speech if she were better informed. One parent had three children with articulation and voice problems about which she had already sought advice. Six were mothers of children with difficult clinical problems with psychiatric implications. Analysis of the data suggests that this course attracted to it mothers who reported mild speech problems about which there was sufficient anxiety to motivate their seeking some help outside a clinical setting. It also attracted mothers whose children had serious problems for which it had been difficult to seek meaningful advice primarily because of anxiety and fear. In fact, half of the mothers who took the course were in need of psychiatric help in one form or another. It would appear that the primary value which these mothers derived from the sessions was the development of enough insight to make it possible for them to seek clinical assistance. We might conclude, therefore, that children in need of help received it only after their mothers had been prepared to accept it. While such a program can in no way replace a speech clinic or turn mothers into therapists, it may well lead a fearful parent to the proper professional door. If this is true, then it is also true that such a course should not be undertaken in the absence of adequate clinical facilities. It would result in increased anxiety for the parent and would surely be injurious to the child.

This experiment in adult education raises a very real question in the minds of educators and clinicians in various disciplines: Is it the function of a university to provide structured courses dealing with human problems in an effort to prepare adults for any professional contacts which they may require? We cannot, on the basis of this single experiment, answer this question even for the speech pathologist. We certainly cannot answer it for physicians, psychiatrists and others who concern themselves with the treatment of various types of disorders. It would appear, however, that some attention might be given to a consideration of the possible uses of adult education as a means for helping disturbed people develop enough understanding to enable them to seek individual help.

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A Descriptive Continuum of Language Responses In Aphasia

As far back in history as Biblical times evidences of aphasia have been recorded, but it has only been in the last century that attempts have been made to understand and treat the disorder. Our knowledge has remained limited even though there has been much impetus given to the importance of aphasia in diagnosis of neurological disease, recognition of recovery, more complete diagnostic procedures and the effects of therapy.

Contradictory statements about aphasia are found in the literature. It may well be that part of the controversy is the failure to describe or define the disorder; *e.g.*, the neurol-

ogist may be more interested in the site of the lesion, its correlates and its significance in diagnosis; the speech pathologist, on the other hand, is usually more concerned with the verbal and/or nonverbal behavior of the patient after the onset of aphasia.

Some of the earlier writings about aphasia were by neurologists who used the terms 'motor' and 'sensory' to describe the language impairment. In later publications written not only by the medical specialists but by speech pathologists and psychologists, such terms as 'expressive,' 'receptive,' 'semantic,' 'global,' 'symbolic' and many others have been employed. Although these may be more descriptive, they do not adequately define the individual's problem of communication.

An assumption is made in this paper that language behavior of aphasics can be pictured on a continuum. This would facilitate interpretation because it describes clinically the level at which the patient is performing in areas of speech, comprehension, reading and writing. The attempt is made to formulate such a descriptive continuum of language responses. It has been used in clinical situations and found beneficial in determining where to begin therapy, in charting the improvement or recognizing that a plateau has been reached, and in communicating information to the medical specialists and staff. The provocative and academic seeds for this classification were the 19th Hughlings Jackson Lecture by T. Alajouanine of Paris and the intensive, reported research of Hildred Schuell.

The continuum can be dissected, analyzed and used advantageously only when all people using the analysis recognize that the subclasses are a clustering of data around an assumed midpoint. This kind of classification has the advantage of making it easier to understand and report the various aspects of the continuum. It certainly has disadvantages in that we may exclude certain behavior from our observation and may fail to report behavior which is observed but not described in the system. Any effort to expand a continuum into an all inclusive one would not only be too detailed, but the complexity of the whole situation would make it impossible to describe accurately every detail. We also realize that matters involving complex stimulations, conditions or phenomena may be studied effectively as single variables but become much more difficult to understand when they are combined, as with combined visual and auditory stimulation in language behavior.

The following schema presents the more observable and overt aspects of the four major areas in an order of poorest to best performance of each aspect. It must be kept in mind that every language segment involves two or more of these parameters. Furthermore, this complex pattern must be studied if the language performance of the individual is to be understood. It is only in a large sample of patients that one will ever see all of these levels demonstrated. No one patient will demonstrate all of them in his recovery.

Language Continuum

I. Effectiveness of Auditory Stimulation
   - A. No observable response to verbal or nonverbal auditory stimulation
   - B. Response to audio-verbal stimulation
     1. Primary incorrect responses
     2. Inconsistent accuracy of responses
     3. More consistent accuracy of responses to simple sentences, questions and commands
     4. Responses to complex auditory stimulation:
        a. some errors
        b. little or no observable error

II. Nature of Speech Response
- A. No oral response
- B. Oral expression without communication
  1. Repetitive, stereotyped sounds, nonsense syllables, words or phrases
  2. Jargon
  3. Jargon with occasional recognizable words or phrases emerging
  4. Correct production of words only after repetition
  5. Incoherent statements because of misuse of recognizable words or unrelated to subject
- C. Oral expression with communication
  1. Conditioned, situational responses
  2. One-word responses:
     a. poorly articulated
     b. correctly articulated
  3. Telegraphic style
  4. Sentence formation but difficulty encountered because of:
     a. inability to call forth specific words or supply information
     b. articulation disorder (inconsistent or consistent)
     c. word substitutions or associations
  5. Breakdown of complicated language occurs when:
     a. a too complex language pattern is required and/or
     b. presence of audience is too threatening

III. Effectiveness of Visual Stimulation
- A. No observable response to any visual stimulation
- B. Responses to visual-verbal stimulation
  1. Can match letters or words only
  2. Responds to words when the printed symbol is combined with oral spelling
  3. Matches printed word with spoken word or with objects
  4. Reads primarily nouns and verbs:
     a. errors usually occur on prepositions, conjunctions, *etc.*
     b. errors made on words which look alike
  5. Responds appropriately to single sentences only
  6. Responds appropriately to paragraphs
  7. Frequency of error increases with complexity of printed material
  8. Responds appropriately to complex materials with no observable difficulty

IV. Nature of Written Response
- A. No observable response to stimulation
- B. Writing responses to stimulation
  1. Illegible copying of letters
  2. Copying of letters and figures
  3. Writes or prints name only
  4. Writes only when word is spelled by or for him
  5. Writes name and a few words
  6. Writes phrases and/or simple sentences but errors may occur in spelling, word use or sentence structure
  7. Writes sentences but errors increase with increased complexity
  8. Writes better to dictation than spontaneously
  9. Little or no observable impairment in writing ability

Conclusion. Other attempts have been made to present an orderly description of behavior of aphasic patients. It is hoped that this continuum will contribute to the organization of the problem of aphasia by raising questions, by stimulating clinicians and by providing a springboard for certain types of research. It is not assumed that this continuum is an end; it is only a beginning in an effort to understand aphasic behavior.

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An Experimental Apparatus for Testing Preschool Children

For experimenters engaged in assessing aptitudes and skills of preschool children, the problem of developing suitable tests in lieu of printed examinations and blanks requiring reading abilities has been a crucial one. A problem of equal import is that of securing and maintaining sufficient motivation, interest and purpose in these young subjects for successful completion of a given test or task,

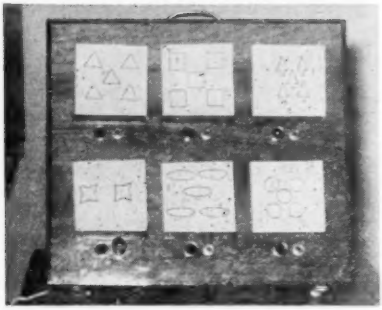

FIGURE 1. The Tracy Box, a device for the presentation of test stimuli.

particularly one demanding a sustained set.

This report represents a description of an experimental apparatus developed at the John Tracy Clinic in conjunction with the standardization of items in a concept formation test for preschool deaf children. Preliminary work with children having other forms of exceptionality suggests that the apparatus, *per se*, appears to have merit for divergent learning and assessment tasks.

Figure 1 shows the Tracy Box, a portable, rectangular, varnished, wooden box that stands at a slight angle on a flat surface. The device is 17 inches wide, 15 inches high, and three and one-quarter inches in depth. Figure 2 shows the electrical schematic of the box.

There are six alternative response positions in two rows of three alternatives each. Each alternative position consists of a four-inch wide, one-quarter inch deep wooden ledge with a red light and a plug jack immediately below. The apparatus was designed so that the subject may indicate a correct response by either pulling on one of six jacks, or by inserting one jack into one of the six apertures (as in Figure 1). By placing a jack in the proper opening (or by pulling the correct jack) a red light is automatically illuminated. A two-second delay then occurs, followed by the automatic dispensing of a small edible sweet by the 'reward' box depicted in Figure 3. Nearly all two-year-old children can operate the jacks in

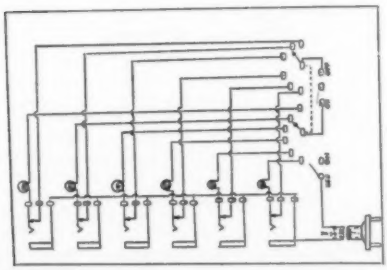

FIGURE 2. Electrical schematic of the Tracy Box.

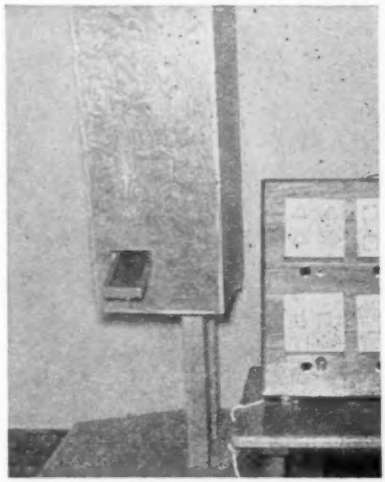

FIGURE 3. Automatic reinforcement apparatus for the dispensation of small edibles.

either manner and appear to comprehend the 'light' as a 'cue' for the edible.

As a result of over two years of application the following conclusions have been reached regarding the apparatus:

1. Motivational impact appears to be provided in terms of securing and maintaining the subject's interest throughout the test.

2. Children appear to take an *active* role in the testing situation, *i.e.*, the subjects appear to realize that it is *their* performance that determines the rewards.

3. The automatic and consistent psychological feedback providing immediate knowledge of results seems to add purpose to the subject's behavior during the assessment.

4. More objectivity and standardization appears to be provided since humans are relieved of providing reinforcement to the subject's responses.

5. The examiners, freed from typical assessment duties, have more freedom and time to appraise other facets of the testing situation.

Acknowledgment. This investigation is supported by a Public Health Service Research grant, 3B-9026 (C2) from the National Institute of Neurological Diseases and Blindness.

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Abstracts

Phillip A. Yantis, *Editor*

Anatomy and Physiology

DEATHERAGE, B. H., ELDREDGE, D. H., and DAVIS, H., Latency of action potentials in the cochlea of the guinea pig. *J. acoust. Soc. Amer.*, 31, 1959, 479-486.

Local interference with the whole-nerve action potential in the cochlea of guinea pigs was produced in several ways: (1) by selective masking, (2) by local fatigue and (3) by local injection of drugs. More specific latent responses are discussed. *(B. A. Landes, Texas Technological College)*

KIANG, N. Y-S., and GOLDSTEIN, M. H., JR., Tonotopic organization of the cat auditory cortex for some complex stimuli. *J. acoust. Soc. Amer.*, 31, 1959, 786-790.

'There is psychophysical evidence that both spectrum and periodicity of acoustical signals may be cues for pitch judgments. At the level of the auditory nerve, these stimulus characteristics seem to be coded in terms of place and time pattern. Very little is known of their representation at higher levels of the nervous system. Tonotopic organization of the auditory cortex has been demonstrated in anesthetized cats by the evoked strychnine potential technique. In these demonstrations only tonal stimuli were used. We use similar physiologic preparations but employ acoustic stimuli that permit independent manipulation of spectrum and periodicity. The results show that the previously reported tonotopic organization is based only upon spectral characteristics of the stimulus.' *(Authors' precis)*

LUCHSINGER, R., Nuevas fotografias laringeas de velocidad reducida. Su importancia para la fisiologia vocal. (New laryngeal photographs in slow motion. Its importance for vocal physiology.) *An. Fonol. Audiol., B. Aires*, 2, 1958, 244-247.

High-speed photographs were taken of the vocal cords of two sopranos and one tenor during singing. From the films a ratio of duration of glottal opening to the period of a total cycle was calculated. This 'quotient' varied with the frequency of the fundamental tone and with the manner of singing successive notes (legato *vs.* staccato). *(R. Goldstein, Jewish Hospital of St. Louis)*

TIMCKE, R., VON LEDEN, H., and MOORE, P., Laryngeal vibrations: measurements of the glottic wave. Part II—Physiologic variations. *Arch. Otolaryng., Chicago*, 69, 1959, 438-444.

Based upon the analysis of photographs made with an ultra high-speed camera of the normal vocal folds in humans, the authors conclude that the following factors are of major importance in the production of the vibratory pattern: the anatomical structure of the vocal folds, changes in air pressure, and the various degrees of multiphasic vibrations that take place during phonation. *(P.A.Y.)*

TONNDORF, J., Beats in cochlear models. *J. acoust. Soc. Amer.*, 31, 1959, 608-619.

The present paper attempts to answer several problems concerned with the perception of beats of mistuned consonances, imperfect unison, and the appearance of the intertone. Cochlear models similar to those of Békèsy were chosen for experimentation. Among the conclusions is that the ear acts more like a pattern analyzer than as a Fourier analyzer. *(B. A. Landes, Texas Technological College)*

General

BARNOW, D., A remarkable response. *Hearing Dealer*, 9, 1959, 16.

The author describes an intensive training program directed toward improving the skills and services of hearing aid dealers. The program was held at the University of Illinois' Allerton Park. K. O. Johnson, E. T. Curry, R. T. Carhart, L. Doerfler, W.

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G. Hardy and H. Newby were among the participants. *(H. J. Oyer, Ohio State University)*

Bradley, W. H., Some relationships between pitch discrimination and speech development. *Laryngoscope, 69*, 1959, 422-437.

Frequency difference limens were obtained in three groups of children, aged nine to 14 years: those with normal hearing and speech; those with normal hearing and articulation defects severe enough to require speech therapy; and those with impaired hearing and impaired speech development. The author feels that his findings support the hypothesis that pitch discrimination is a contributing factor in the development of speech and language in hearing-impaired children, and that such discrimination may be a contributory factor in the development of speech for children with articulatory defects. *(P.A.Y.)*

Chase, R. A., Sutton, S., and First, D., Bibliography: delayed auditory feedback, *J. Speech Hearing Res.*, 2, 1959, 193-200.

A nonannotated bibliography in the subject area is presented, consisting of 147 references. *(B. A. Landes, Texas Technological College)*

Forrer, G., The mother of a defective child. *Psychoanal. Quart.*, 28, 1959, 59-63.

The author discusses the psychological impact which accompanies overattachment of a mother to her defective child. *(H. J. Oyer, Ohio State University)*

Gordon, J. E., Relationships among mother's n achievement, independence training attitudes, and handicapped children's performance. *J. cons. Psychol.*, 23, 1959, 207-212.

This research was designed to test the hypothesis concerning the relationships among the mother's n achievement, independence training attitudes, and hearing handicapped children's performance. Subjects were 19 mothers and their deaf preschool children. Six TAT cards were administered to the mothers, following McClelland's standard instructions, and their stories scored for n achievement according to McClelland's criteria. The mothers were also administered part of Winterbottom's Independence Training Questionnaire, once with reference to the deaf child, and once with reference to their normal hearing children. Social maturity relative to intellectual ability was measured in the deaf children by the discrepancy between Merrill-Palmer and Vineland Social Maturity Scale scores.

The major results were: (1) attitudes favoring early independence in normal children were found in the mothers of deaf children who showed relatively large Merrill-Palmer discrepancies; (2) independence training attitudes toward deaf children and discrepancies between attitudes toward deaf and normal children were not associated with Merrill-Palmer—Vineland discrepancies; (3) mothers with low achievement needs tended to be moderate in their independence training attitudes toward normal children, while high n achievement mothers tended toward the extreme positions of favoring very early or very late independence; and (4) high n achievement mothers favored significantly later independence in deaf children than did low n achievement mothers. *(B. S. Street, Minneapolis)*

Nelson, M., Electrocutaneous perception of speech sounds. *Arch. Otolaryng., Chicago, 69*, 1959, 445-448.

Ten normal-hearing subjects were asked to make a judgment of similarity or dissimilarity between two vowel sounds in 20 different combinations by cutaneous stimulation. Each of the stimuli were compressed and were subjected to controls of time and intensity. It was found that under the conditions of the study most of the subjects could differentiate controlled vowel sounds cutaneously. *(P.A.Y.)*

Ronnei, E. C., and Fowler, E. P., Sr., Deafness prevention in children. *Arch. Pediat.*, 76, 1959, 186-188.

This report is concerned with the loss of hearing for the middle tones, particularly those between 500 and 3000 cycles inclusive, with hearing for the tones above and below this frequency band being within normal limits as determined by audiometry.

The authors consider a middle-tone loss to be congenital in origin. Pathohistological findings show a large destruction of hair cells on the basilar membrane in the middle turn of the cochlea, with little or no loss of these cells at the base or apex of the cochlea. The audiometric curve is shaped like a 'U,' the upper parts of the 'U' being near the zero line and the middle of the 'U' showing losses varying from 40 to 90 db.

The authors feel that children with this type of hearing impairment do learn to

speak quite normally and to understand language and speech quite well, although they are often labeled 'slow talkers.' Detection of this type of hearing loss is difficult in young children because they can hear faint sounds like a cat's purr (low) or a bird's chirp (high). *(M Nelson, Michigan State University)*

RUSSELL, D., Auditory abilities and achievement in spelling in the primary grades. *Educ. Psychol.*, 49, 1958, 315-319.

The relationship of scores obtained by 85 first, second and third graders on six tests of auditory discrimination, and scores on intelligence, spelling and reading tests were computed. The study revealed that some verbal auditory skills are significantly related to both spelling and reading ability and that these abilities involved recognition of word parts rather than whole words. *(H. J. Oyer, Ohio State University)*

SIEGEL, G. M., Dysphasic speech responses to visual word stimuli. *J. Speech Hearing Res.*, 2, 1959, 152-160.

Investigation of dysphasic speech behavior relative to certain parameters of words indicates more errors on adjectives than nouns or verbs, more errors on long words than short, more errors on infrequently occurring words, and more errors on words of high or low abstraction level than on those of medium abstraction level. *(B. A. Landes, Texas Technological College)*

Pathology

DOUGLASS, E., and RICHARDSON, J. C., Aphasia in a congenital deaf-mute. *Brain*, 82, 1959, 68-80.

A case history of a 21-year-old deaf-mute who developed an intra-partum stroke with right hemiplegia and dysphasia is presented. The following findings were noted: (1) Visual recognition was intact. Single words and short sentences could be comprehended, but the patient failed when asked to read a paragraph. (2) Recognition and comprehension of single letters in finger spelling was intact. The patient made errors in comprehending single words when they were finger spelled. The same difficulty was present as applied to basic or universal sign language. (3) Recognition of single numerals was intact. The patient made errors in simple calculation. (4) Ability to copy was intact. The patient could not write single words, describe scenes from pictures nor produce spontaneous expression of thought. (5) Ability to imitate gross movements and to imitate finger spelling of numerals was intact. The patient made errors finger spelling letters and words. The error response was often similar to the correct response. The patient was impaired in ability to use basic sign language. *(B. S. Street, Minneapolis)*

FRY, D. B., Phonemic substitutions in an aphasic patient. *Lang. and Speech*, 2, 1959, 52-61.

The author analyses and compares the phonemic substitutions occurring in the speech of an aphasic patient with the confusions listed in published material referring to the development of speech in children. It was found that the evidence obtained in this particular case contradicts the idea that the degeneration of speech in aphasia mirrors its development in childhood. *(P.A.Y.)*

VAN GELDER, L., De open neusspraak. Pathogenese en diagnostiek. (Open nasal speech. Pathology and diagnosis.) *Logop. Phoniat.*, 31, 1959, 49-60.

The author describes the causes, phonetic and clinical aspects of open and closed nasal speech, and discusses soft palate function in speech production through the use of X rays. *(P.A.Y.)*

HESS, D. A., Pitch, intensity, and cleft palate voice quality. *J. Speech Hearing Res.*, 2, 1959, 113-125.

Recordings of 15 adult cleft palate speakers were judged for nasality, breathiness, harshness and hoarseness. Results indicate that although breathiness is unaffected by pitch level, the other factors decrease in severity with higher pitch levels. As intensity increases, nasality, breathiness and hoarseness decrease while harshness increases. *(B. A. Landes, Texas Technological College)*

RIESE, W., Semantic aphasia II. *J. nerv. ment. Dis.*, 128, 1959, 302-307.

This article discusses a patient afflicted with semantic aphasia. The language syndrome was very similar to another of the author's patients so afflicted and to those depicted by Head. Details of language were preserved, but general orientation and the ability to grasp the whole were affected. Head claimed that in semantic aphasia the brain lesion was diffuse but centered in the supramarginal gyrus and the superior parietal lobule. Riese found the lesion in his patient to be more extensive than Head postulated

and, contrary to Head, he found his patient's lesion to be in the angular gyrus, posterior temporal area and the adjacent occipital structures. The lesions were both subcortical and cortical.

The author concludes that similar speech symptoms can result from lesions in different sites and differing in sizes; the major site may be similar, but no one specific area can be destroyed to produce semantic aphasia. *(E. H. Nober, Adelphi College)*

SCHLESINGER, E., ALLAWAY, N., and PELTIN, S., Survivorship in cerebral palsy. *Amer. J. publ. Hlth*, 49, 1959, 343-349.

The authors followed 3,108 cerebral palsy cases for seven and one-half years; all were below the age of 18 years at the time of the initial report. There were 205 deaths—13 times the expected 9.6 per 1000 in males, and 17 times the 8.5 per 1000 expected incidence among females.

The group with severe physical limitations had 27-30 times the mortality rate of the general population of corresponding age and sex, while the mild group's mortality was four-to-five times greater. The mentally retarded group had a death incidence 30 times greater than the normal population of corresponding age and sex. *(E. H. Nober, Adelphi College)*

Psycho-Acoustics

DAVID, E. E., JR., GUTTMAN, N., and VAN BERGEIJK, W. A., Binaural interaction of high-frequency complex stimuli. *J. acoust. Soc. Amer.*, 31, 1959, 774-782.

'An experiment is described in which time and intensity differences of 2-kc high-pass clicks were mutually offset to produce sound images centered in the head. Binaurally correlated and uncorrelated clicks were used, and the trade was tested at 10-70 db SPL. The results show that generally the two types of clicks behave similarly, and that up to 60 db SL, at least, as over-all intensity increases, the time difference compensating a given intensity difference (in db) decreases. A function is derived describing what is interpreted as a physiological intensity-to-time conversion. The place of such a conversion in lateralization is discussed.' *(Authors' precis)*

DEATHERAGE, B. H., and HIRSH, I. J., Auditory localization of clicks. *J. acoust. Soc. Amer.*, 31, 1959, 486-492.

It has been established that factors contributing to localization are relative intensity and phase of signals reaching the two ears. An attempt was made to equalize the effects of one factor by increasing the other. It was found that midline localization could be induced by increasing intensity to offset temporal differences. The necessary intensity increase varies as a function of the sound level. *(B. A. Landes, Texas Technological College)*

EGAN, J. P., SCHULMAN, A. I., and GREENBERG, G. Z., Operating characteristics determined by binary decisions and by ratings. *J. acoust. Soc. Amer.*, 31, 1959, 768-773.

Two experiments were performed to determine the operating characteristics of the two methods of signal detection within the theory of signal detectability. It was determined that the listener performs as well with a multiple criteria method as when he uses the binary-decision method. *(B. A. Landes, Texas Technological College)*

GARNER, W. R., On the lambda loudness function, masking, and the loudness of multicomponent tones. *J. acoust. Soc. Amer.*, 31, 1959, 602-607.

The lambda loudness function was previously proposed as the basis for a loudness scale superior to scales currently in use such as the sone scale. The present paper utilizes this lambda function to compute the loudness of multicomponent tones, using the masking data of Wegel and Lane as part of the primary data. It is concluded that the lambda loudness function will have greater generality than previous scales. *(B. A. Landes, Texas Technological College)*

HIRSH, I. J., Auditory perception of temporal order. *J. acoust. Soc. Amer.*, 31, 1959, 759-767.

'Whereas temporal intervals as short as a few milliseconds are sufficient to separate two brief sounds so that a listener will report that there are two (instead of only one) sounds, a longer separation time of between 15 and 20 msec is required for the listener to report correctly which of the two sounds precede the other. This minimum temporal interval appears to be independent of the kinds of sounds used: whether short or long, of high or low frequency, of narrow or wide band width. There is some suggestion that rise-time and duration may change this minimum interval, but these somewhat secondary relations are not investigated in detail here. The length of the required interval suggests that the judgment of order requires other mecha-

nisms than those associated with the peripheral auditory system.' *(Author's precis)*

LIEBERT, R., and RUDEL, R., Auditory localization and adaptation to body tilt: a developmental study. *Child Development*, 30, 1959, 81-90.

Children, ages five through 17 years, were subjects in this experiment. They were asked to localize clicks as they were displaced from upright position in a tilting chair. Results show that error in localization decreases as age increases. *(H. J. Oyer, Ohio State University)*

PLOMP, R., and BOUMAN, M. A., Relation between hearing threshold and duration for tone pulses. *J. acoust. Soc. Amer.*, 31, 1959, 749-758.

A new hypothesis is introduced concerning the effect on threshold of duration of tone pulses. A formula is derived which gives a correction to account for very short durations. *(B. A. Landes, Texas Technological College)*

ROGER, F. L., The formation of concepts with nonverbal auditory stimuli. *Amer. J. Psychol.*, 72, 1959, 17-32.

This study of concept-formation in the area of audition compared the learning of concepts based upon a prominent partial in a harmonic complex tone with the learning of concepts based upon the harmonic structure of a complex tone. A second purpose was to determine the effect upon the formation of concepts of both prior experience with stimuli and hierarchical order. Complex tones and nonsense syllables were presented as paired associates. During a time interval of two seconds preceding the next stimulus, the subjects attempted to give the correct response. Results in the first study indicated that there was no significant difference found. The second study indicated that prior experience with stimuli facilitates concept formation. The author states that the concept-formation experiment may be applied to the problems of audition, contributing valuable information on the utility of the dimension for signal devices and to the determination of 'auditory intelligence.' *(B. B. Schlanger, West Virginia University)*

SCHARF, B., Loudness of complex sounds as a function of the number of components. *J. acoust. Soc. Amer.*, 31, 1959, 783-785.

Loudness is found to be invariant with the number of components in a complex sound. Possible reasons for this phenomenon are discussed. *(B. A. Landes, Texas Technological College)*

SHARF, D. J., Intelligibility of reiterated speech. *J. acoust. Soc. Amer.*, 31, 1959, 423-427.

In an attempt to increase speech intelligibility, blank spaces in a recording were filled with repetitions of speech samples. Results indicate little differences in intelligibility of reiterated speech as compared with intelligibility of interrupted speech in quiet. In noise, reiterated speech is more intelligible. *(B. A. Landes, Texas Technological College)*

SMALL, A. M., JR., BACON, W. E., and FOZARD, J. L., Intensive differential thresholds for octave-band noise. *J. acoust. Soc. Amer.*, 31, 1959, 508-510.

The effects of band widths of noise of different center frequencies and different sensation levels on the size of the differential threshold was investigated. Results indicate that differential thresholds were larger for the lower noise bands. Further results are discussed. *(B. A. Landes, Texas Technological College)*

SOLOMON, L. N., Search for physical correlates to psychological dimensions of sounds. *J. acoust. Soc. Amer.*, 31, 1959, 492-497.

Fifty subjects ranked a series of passive sonar sounds in terms of their psychological characteristics on seven dimensions. These were correlated with physical dimensions. Certain meaningful relationships, which are discussed, were found. *(B. A. Landes, Texas Technological College)*

SWETS, J. A., Indices of signal detectability obtained with various psychophysical procedures. *J. acoust. Soc. Amer.*, 31, 1959, 511-513.

'The index of detectability d' was estimated from data collected with various psychophysical procedures, specifically, the forced-choice method with different numbers of alternatives, and the yes-no method. The estimates were, in all instances, quite comparable. This result is comforting in view of the fact that none of the other indices extant provide a unification of data collected with different procedures. This result is also somewhat surprising in view of the fact that the calculation of d' assumes

perfect memory, and forced-choice experiments were conducted with as many as eight temporal alternatives.' *(Author's precis)*

Rehabilitation

DARLEY, F. L., SHERMAN, D., and SIEGEL, G. M., Scaling of abstraction level of single words. *J. Speech Hearing Res.*, 2, 1959, 161-167.

Thirty-five judges rated 572 words (nouns, adjectives and verbs) on a five-point scale level of abstraction. Statistical analysis provided evidence that the words can be scaled reliably. Words were ultimately grouped according to the scaled judgments of level of abstraction and it is proposed that the list may serve as an important tool for future research as well as therapy. *(B. A. Landes, Texas Technological College)*

HARRISON, S., Integration of developmental language activities with an educational program for mentally retarded children. *Amer. J. ment. Def.*, 63, 1959, 967-970.

The language development aspect of a program designed to study the effect of nursery-kindergarten experiences on the immediate and subsequent behavior and adjustment of educable mentally retarded children four-to-six years old is conceived of as one major means of contributing to the effectiveness of the classroom program. Curricular experiences are utilized as motivation for communicative behavior through both separate and combined efforts of teachers and language developmentalists. During experiential episodes the language developmentalist has the opportunity to relate oral language directly to the activity in which the child is engrossed. As much of the communication with retarded children is on a nonverbal level, people who work with retardates must, therefore, utilize nonvocal language for derivation of meaning essential to the development of programs promoting growth in language skills. *(B. B. Schlanger, West Virginia University)*

JOLLES, I., The training of language and conceptual thinking in the child with brain damage. *J. So. African Logopedic Soc.*, 5, 1958, 7-9.

Teachers of the educable mentally handicapped are often perplexed by children who respond readily to the nonacademic program but fail in achieving satisfactory growth in reading ability. The author describes an instructional approach and a teaching sequence of value in training pupils to form concepts necessary to the development of language. Beginning with the introduction of concrete objects, the plan progresses through the use of pictures and the spoken word to the printed word. (Courtesy *Rehab. Lit.*)

LA FOLLETTE, A. C., Plans for a summer speech correction clinic. *Speech Teacher*, 8, 1959, 161-163.

The objectives and routine for a six-week summer program are outlined. Classes meet Monday through Friday inclusive. From 9:00 to 9:30 is group therapy through word study, 10:00 to 10:20 is therapy through social patterns, and the 10:30 to 11:00 session is subdivided to meet individual needs. Opportunity is provided for 15 minutes of private lessons, when indicated. *(E. H. Nober, Adelphi College)*

MERKELEY, H. J., Cleft palate prosthesis. *J. prosth. Dent.*, 9, 1959, 506-513.

The construction of a sliding hinge-type obturator is described. Emphasis is given to the anatomic structures and their relation to the parts of the speech appliance. *(A. K. Kaires, U. S. Navy)*

MOSES, P. J., Pathology and therapy of the singing voice. *Arch. Otolaryng., Chicago*, 69, 1959, 577-582.

The author presents a general discussion of various diagnostic and therapeutic problems arising in vocal disorders of singers, including functional disorders and amusia. *(P.A.Y.)*

POLLOCK, M. S., Releasing the true intellectual capacities of a young aphasic child through the unfettering of emotional bonds. *Amer. J. ment. Def.*, 63, 1959, 954-966.

An individualized educational program for a nonspeaking child is completely detailed. Progress over a period of several years is outlined. The role of the educator is stressed as the writer suggests that he begin the program for the aphasic child before the age of six. While truer intellectual capacities are revealed once the child is able to speak, the educator may obtain clues to the child's intelligence through his graphic expressions. *(B. B. Schlanger, West Virginia University)*

VOGEL, K., Bedeutung und Aussichten der Hörerziehung bei hochgradig schwerhörigen Kindern auf Grund bisheriger eigener

Erfahrungen. (Significance and expectations of education in severely hard of hearing children based on the writer's experience to date.) *H N O, Berlin*, 7, 1959, 208-212.

After discussing the techniques of teaching the severely hard of hearing child to speak, the author evaluates the help that is offered by modern hearing aids. He also describes methods of auditory training. Some cases are described in which auditory training was successfully performed with the help of a hearing aid. After one and one-half to two years' training, some of his patients could be sent to schools. He recommends the use of teachers trained especially to give these hearing exercises. Special schools for the hard of hearing (several grammar schools, one high school) exist in Germany. Of 15 children, five could enter normal schools after training. *(E. Froeschels, New York City)*

Speech Science

FLANAGAN, J. L., Estimates of intraglottal pressure during phonation. *J. Speech Hearing Res.*, 2, 1959, 168-172.

Estimates are made from previously reported data of the pressure variations at the entry outlet of the glottal port. A phase difference is suggested in the motions of the upper and lower edges of the vocal folds in some types of phonation. *(B. A. Landes, Texas Technological College)*

LEHISTE, I., and PETERSON, G. E., Vowel amplitude and phonemic stress in American English. *J. acoust. Soc. Amer.*, 31, 1959, 428-435.

Speech power, fundamental voice frequency, vowel quality, duration, and possibly laryngeal quality all appear to make significant contributions to perceptual judgments of linguistic stress. *(B. A. Landes, Texas Technological College)*

MILLER, R. L., Nature of the vocal cord wave. *J. acoust. Soc. Amer.*, 31, 1959, 667-677.

The shape of the vocal cord wave was determined by two independent methods: by frame-by-frame analysis of motion pictures of the vocal cords, and by the derivation and use of a network having a characteristic which is the inverse of the first vocal resonance. Harmonic analysis of the wave resulting from the study of vocal cord opening shows that a uniform distribution of harmonic amplitudes does not often occur. The second analysis shows that the speaker can control to an extent the magnitude of higher resonance excitations at the point of vocal cord closure. *(B. A. Landes, Texas Technological College)*

NAKATA, K., Synthesis and perception of nasal consonants. *J. acoust. Soc. Amer.*, 31, 1959, 661-666.

Using a terminal-analog synthesizer and control device, a number of syllables consisting in a nasal consonant followed by a vowel were produced. It is again shown that the second formant is particularly important in the identification of the nasal consonants. Identification is also somewhat dependent on the duration of the consonant and the transition portions of the syllable. *(B. A. Landes, Texas Technological College)*

PETERSON, G. E., Vowel formant measurements. *J. Speech Hearing Res.*, 2, 1959, 173-183.

The author presents a discussion of the measurement of vowel formant frequencies on the basis of modern instrumentation and within the concept that the vocal mechanism in speech communication is the basic information source. 'It is concluded that measurements of the peaks of the vowel envelope curves provide the most meaningful data regarding vowel formant frequencies.' *(B. A. Landes, Texas Technological College)*

TOBIAS, J. V., Relative occurrence of phonemes in American English. *J. acoust. Soc. Amer.*, 31, 1959, 631.

Previous attempts to record relative occurrence of American English phonemes have been based on written material, radio announcements, and the speech of 30-month-old children. The system of collection of data which seems best, however, is that of French, Carter and Koenig who used telephone conversation material. The present author retabulated these data and concludes that adherence to the original French, Carter and Koenig tables will not lead to serious error. Nevertheless, a more accurate tabulation is presented from these data. *(B. A. Landes, Texas Technological College)*

Testing and Measurement

ARNOLD, G. E., Estudios audiologicos en escolares dislexicos. (Audiologic studies in

dyslexic students.) *An. Fonol. Audiol., B. Aires*, 2, 1958, 271-277.

Pure-tone and speech thresholds were normal bilaterally in 48 of 65 dyslexic students. In the remaining 17 the losses were unilateral or too minor to account for any of the reading problems encountered. *(R. Goldstein, Jewish Hospital of St. Louis)*

CHARGEISHVILI, A. K., TOKHADZE, T. L., and POLSHIN, V. V., Elektromiograficheskoie issledovanie rechi kak sposob izuchenia funktsional'nogo sostoiania slukhovogo analizatora. (Electromyographic investigation of speech as a mode of studying the functional state of the auditory analyzer.) *Vestnik O.R.L., Moskva*, 3, 1959, 9-13.

Registration of 'inner speech' is carried out by comparing electromyography of speech muscles in malingerers and normally-hearing persons. The authors develop a conditioned reflex associating a light with a pure tone while pronouncing the word 'red.' After 10-15 associations the oscillogram shows an intensification of myoelectrical impulses, indicating a speech response even though the word is not pronounced aloud. In all instances it is possible to detect a threshold for all tones. The authors expect to apply their method to an objective investigation of hearing after they achieve certain technical improvements and simplifications. *(B. V. Morkovin, University of Southern California)*

CORSO, J. F., Age and sex differences in pure-tone thresholds. *J. acoust. Soc. Amer.*, 31, 1959, 498-507.

In order to gather data on normal hearing as a function of sex and age for use in medicolegal problems, various age groups (18-24, 26-32, 34-40, 43-49) consisting of persons who had not been exposed to high industrial noise levels were tested for threshold acuity. The subjects also underwent a thorough otological examination. Results indicate that females tend to have more acute hearing than males, independent of age. Hearing acuity decreases as a function of age for both men and women, and the precise data of the study are offered for consideration in the establishing of norms. *(B. A. Landes, Texas Technological College)*

DOERFLER, L. G., and KRAMER, J. C., Unconditioned stimulus strength and the galvanic skin response. *J. Speech Hearing Res.*, 2, 1959, 184-192.

Subjects who were conditioned with a maximal level of shock intensity showed greater resistance to extinction of conditioning than did subjects who were clinically or minimally conditioned. *(B. A. Landes, Texas Technological College)*

GUELKE, R. W., and HUYSSEN, R. M. J., Development of apparatus for the analysis of sound by the sense of touch. *J. acoust. Soc. Amer.*, 31, 1959, 799-809.

'An apparatus is described that applies the frequency components of speech, as spoken into a microphone, to the fingers of one hand with the purpose of enabling a deaf person to comprehend speech. Frequency is indicated by position along the fingers. The sense of touch is not called upon to make any direct frequency discrimination by distinguishing vibrational sensations of different frequencies as in previous attempts of this nature . . . The frequency analysis is done partly electrically and partly mechanically. Small tuned steel reeds are used for the final frequency analysis. These steel reeds also serve as transducers by operating directly against the fingers. The results of a short series of experiments on a deaf person are promising but the recognition of individual components is difficult.' *(B. A. Landes, Texas Technological College)*

JERGER, J. F., CARHART, R., TILLMAN, T. W., and PETERSON, J. L., Some relations between normal hearing for pure tones and for speech. *J. Speech Hearing Res.*, 2, 1959, 126-140.

A small group of audiologically sophisticated and a large group of audiologically naive subjects were tested for pure-tone threshold at 1000 cps as well as for spondee threshold. Results indicate a medial difference of approximately 13 db between the obtained results. 'It represents a value which might properly be selected as the relationship to be specified for audiometric standards.' *(B. A. Landes, Texas Technological College)*

LAWRENCE, C. F., and RUBIN, W., The efficiency of limited frequency audiometric screening in a school hearing conservation program. *Arch. Otolaryng., Chicago*, 69, 1959, 606-611.

In an attempt to ascertain the applicability of using only one or two frequencies for auditory screening of school children, a total of 2536 children were given screen-

ing tests of either or both the routine type (octave frequencies from 250 to 8000 cps) and a recently proposed limited-frequency type (only 2000 and 4000 cps). Each of the screening tests was carried out at an intensity level of 15 db *re* audiometric zero for each frequency. It was found that a limited-frequency test using 500 and 4000 cps would best meet reasonable criteria for agreement with the standard sweep-check test. *(P.A.Y.)*

MILLER, M. H., Clinical application of paired masking enclosures in pure-tone air- and bone-conduction testing. *Arch. Otolaryng., Chicago,* 69, 1959, 315-328.

'A simple audiotesting assembly was constructed consisting of two wooden enclosures which were used to present different types of masking noises to the nontested ears of each of the subjects in the study (31 subjects). The thresholds obtained on the poorer ears of the subjects when the masking enclosures were used were compared with those obtained when conventional audiometric procedures using earphones were employed. It was found that the results obtained when the specially constructed audiotesting assembly was used were in generally better agreement with the otologists' findings and diagnoses than were those of conventional audiometric procedures when the two testing approaches showed different results. . . .' *(P.A.Y.)*

QUARRINGTON, B., Measures of stuttering adaptation. *J. Speech Hearing Res.*, 2, 1959, 105-112.

A measure of adaptation in stuttering is proposed which is derived statistically and which has a higher test-retest correlation than more simply derived measures of relative decrease. *(B. A. Landes, Texas Technological College)*

SELLERS, L. M., False positive perception deafness tests. *Laryngoscope,* 69, 1959, 493-508.

The author presents eight cases, together with audiologic findings, of patients who showed evidence of a perceptive loss by pure-tone audiometric and loudness-balance recruitment tests. Each case was later proved to have a loss due to middle-ear pathology. *(P.A.Y.)*

SOKOLOV, E. N., and PARAMONOVA, N. P., Objective examination of the residual hearing of deaf children. *Trans. Beltone Inst. Hearing Res.*, 10, 1959. A translation of a chapter in the book *Ostatochnyĭ Slukh u Tugoukhikh i Glukhonemykh Deteĭ*, published by the Academy of Pedagogic Sciences of the RSFSR, Moscow, 1957.

In order to test and compare audiometric threshold results on a population of 10-15 year old deaf-mutes (N=32), simultaneous responses to tones were registered by means of electroencephalograms (parietal and occipital), galvanodermograms (palmar and dorsal), and electromyograms (wrist extensors). The EEG and GDR responses were unconditioned, whereas the EMG response was produced as a result of a conditioned motor reaction. Analysis of results leads to the suggestion that 'the so-called remnants of hearing in deaf-mutes is a vibratory sensitivity' rather than an auditory sensitivity. *(B. A. Landes, Texas Technological College)*

TILLMAN, T. W., and JERGER, J. F., Some factors affecting the spondee threshold in normal-hearing subjects. *J. Speech Hearing Res.*, 2, 1959, 141-146.

Experimental evidence shows that subjects who have been acquainted with the spondee vocabulary yield thresholds which are 4-5 db lower than thresholds obtained from subjects who have not been so acquainted. *(B. A. Landes, Texas Technological College)*

VENTRY, I. M., and NEWBY, H. A., Validity of the one-frequency screening principle for public school children. *J. Speech Hearing Res.*, 2, 1959, 147-151.

1517 school children were given individual sweep tests. Threshold tests were performed on 90 ears which failed the sweep test. Threshold analysis reveals a significantly greater loss at 4000 cps than at other frequencies in the 500-8000 cps range. 'The validity of the single-frequency principle, at least under the conditions of this study, appears to be established.' Additional research is needed, however. *(B. A. Landes, Texas Technological College)*

WARD, W. D., GLORIG, A., and SKLAR, D. L., Relation between recovery from temporary threshold shift and duration of exposure. *J. acoust. Soc. Amer.*, 31, 1959, 600-602.

Fourteen normal listeners were exposed to TTS-producing stimuli (1200-2400 cps noise) at different exposure levels for different exposure times. The course of re-

covery from the TTS was charted. It is concluded that at 3000 and 4000 cps, recovery is 'uniquely determined by the value of TTS at 2 min recovery: *i. e.*, by the TTS remaining after the first fast recovery process.' *(B. A. Landes, Texas Technological College)*

WARD, W. D., GLORIG, A., and SKLAR, D. L., Temporary threshold shift from octave-band noise: applications to damage-risk criteria. *J. acoust. Soc. Amer.*, 31, 1959, 522-528.

Subjects who had been exposed to octave-band noise showed the same linear TTS recovery as has been noted for exposure to wide-band noise. Rate of growth of the TTS varies as a function of frequency or exposure band and test frequency. In terms of damage-risk criteria, ear protection is suggested when octave-band noise exceeds 85 db SPL, and is required when the noise exceeds 95 db SPL. *(B. A. Landes, Texas Technological College)*

WARD, W. D., GLORIG, A., and SKLAR, D. L., Temporary threshold shift produced by intermittent exposure to noise. *J. acoust. Soc. Amer.*, 31, 1959, 791-794.

'The TTS at four kc was measured two and 17 min after successive 12-min exposures to broad-band noise at 106 db SPL separated by 18 min of silence. The results indicate that the TTS existing at the beginning of a particular exposure can be treated as additional time of exposure. Thus, if the residual TTS has a value that would be produced by R min of exposure, then the total TTS at the end of an M-min exposure will be given by solving the equation for growth of TTS with exposure time set equal to $M+R$.' *(Authors' precis)*

Book Reviews

Ernest H. Henrikson, *Editor*

NOTE: At the request of the Book Review Editor and with the concurrence of the Committee on Publications, I am pleased to present the following statement concerning the change in policy affecting book reviews that is being introduced in this issue of the *Journal of Speech and Hearing Disorders.*

The publication of a book of sufficient importance to speech pathologists and audiologists to warrant review in the *Journals* of the American Speech and Hearing Association is an event of considerable professional significance, and it is in the best interests of all concerned that a review of any such book be prepared with due regard for its potential influence. There are many procedures to be used in the reviewing of books, and it is by no means obvious which of these is best. One consideration which seems to be basic, however, is that it is the author of a book who is likely to be the most familiar with its specific content and with his own decisions and purposes in writing the book. It seems desirable, therefore, to make appropriate use of the author in the reviewing process. The plan we have devised is that of providing the author of each book reviewed in these pages with the opportunity—which he is free to forego, of course—to comment on the review in the same issue in which the review appears. The space allowed the author may equal that used by the reviewer. It is our purpose in introducing this policy to give our readers descriptions and evaluations of books that are as authentic and engaging as possible. The Book Review Editor and the Committee on Publications will be most appreciative of readers' reactions to the new policy.

—WENDELL JOHNSON

Editor of the Association and Chairman of the Committee on Publications

AMERICAN PUBLIC HEALTH ASSOCIATION, INC., COMMITTEE ON CHILD HEALTH, *Services for Children with Epilepsy*. New York: American Public Health Association, Inc., 1958. Pp. 124. $1.50.

Services for Children with Epilepsy presents an account of the services and facilities now available in the treatment of epilepsy. Furthermore, the book reflects the progress in terms of knowledge of causes and prevention, diagnosis, treatment and management, and the organization of community resources now available to individuals with epilepsy.

Epilepsy in itself does not prove to be a handicapping condition in the majority of cases and although many individuals with epilepsy may develop psychological or psychiatric disturbances, epilepsy *per se* is not the basic etiological factor. Individuals with epilepsy may become vulnerable to psychiatric or psychological adjustment because of their rejection by the family, as well as an ill-informed society.

A basic objective of *Services for Children with Epilepsy* is the enlightenment of family and society concerning the nature of epilepsy and its implications. Another

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basic objective indicates the methods and treatment necessary for returning the child to his environment as an adjusted individual, at the same time providing facilities for his continued well being.

The book is divided into nine sections with five appendices. Section 1 handles concepts and facts about epilepsy and its meaning to the community, especially the interrelationships of the child and family. This section allocates the responsibility for services and programs to the proper agencies. Section 2 deals with causes and prevention, and provides specific information about preventing the occurrences of epilepsy and the means of alleviating the handicapping effects of seizures. Section 3 details the case-finding techniques used in locating and referring the children for diagnostic studies. The machinery for referrals is outlined and the application of case-finding statistics employed.

Section 4 concerns itself with diagnosis and planning for the care of children who have been detected. Medical and psychological appraisals become essential to the planning for the care of these individuals. Section 5 elaborates on treatment and management. Treatment and management embrace medical supervision and treatment, psychosocial aspects of care, education, recreation, vocational planning, and continuation of treatment and care of children who have seizures. Sections 6 and 7 provide a comprehensive view of the different facilities and services available in terms of local clinics, in-patient hospital services, special centers and educational facilities, and residential care. Principles in community planning with the mobilization of community resources in continued coordinated efforts based on intensive team approach, are spelled out in detail. Section 8, on research, suggests that research in sociology, psychology, education, and public health, lag behind medical research. So long as these conditions exist, gaps in understanding and lags in services will continue. The book also identifies specific areas of research including marriage, motor vehicle licensing, immigration, and employment compensation. Further research into the incidence and prevalency of epilepsy, employment opportunities, effective educational methods and programs, contributions of social and emotional stresses and familial and community attitudes, as additional topics for research, are recommended. Section 9 provides 11 criteria for evaluating programs. The book contains a selected bibliography.

Louis M. DiCarlo
Syracuse University

Authors' Comment: I have read Dr. DiCarlo's review of the publication *Services for Children with Epilepsy*, with great interest. I was closely 'involved' in the preparation of this Guide in my capacity as staff member of the American Public Health Association's Committee on Child Health. Working with this committee and its advisory groups on the public health aspects of epilepsy in children was a most stimulating experience, and I am naturally curious and concerned about how this publication is received.

Children subject to seizures *are* handicapped if they are not given adequate professional help. Such help can and should be made available—and the chief objective of this Guide is to emphasize facts and points of view about epilepsy so that professional people will have a background of understanding and knowledge in providing services. In his review, Dr. DiCarlo was apparently impressed by the breadth and detail of the coverage. He did not state any opinion about the practical value of the material or the effectiveness of its presentation. From the reports we have received from those who are using the Guide—in teaching centers, clinics, public health and education departments, and other professional settings—we know it is meeting a real need and that its message is being felt.

This Guide is one of a series of 11 publications on services for children with handicapping conditions. Other guides in the series, of possible interest to your readers, were published in 1955-1956, and include: *Services for Children with Cerebral Palsy, Services for Children with Cleft Lip and Cleft Palate, Services for Children with Dentofacial Handicaps, and Services for Children with Hearing Impairment.*

Elinor F. Downs
Booth Bay Harbor, Maine

Hockett, Charles F., *A Course in Modern Linguistics*. New York: The Macmillan Co., 1958. Pp. 621. $7.50.

It is impossible, in the short space allotted, to do full justice to this fine book. Professor Hockett (Linguistics and Anthropology at Cornell University) tells us in his preface that his book 'is intended for those students who take an introductory course in lin-

guistics.' It is his desire, he asserts, to present in an orderly fashion the generally accepted facts and principles of the field. As to approach and method, he disavows any desire to popularize, aiming rather at simplicity of presentation. If he has not popularized, he has, nevertheless, presented his material attractively, and he has covered the ground in a masterful way. Even in the discussion of technical matters, he is clear, precise and convincing.

While he apologizes at times for the inadequacy of his coverage (needlessly, most readers would feel), he makes amends for this by reference to other, and often more specialized, scholars, both in his text and in his exhaustive bibliography; and incidently, he has been more than usually generous in acknowledging indebtedness. At the close of each chapter he lists the new terms defined and used, and in some cases adds problems based on the chapter material.

The phonology in particular is effectively done. To this reviewer the most useful chapters are 7 (phonetics); 8 (contoid articulations); and 9 (vocoid articulations). The section on 'Phonology and Grammar,' with subtitle 'Levels of Patterning,' is rich in material and conclusions and close to entertainment in its excellent presentation. In 'Grammatical Systems,' Hockett makes traditional grammar look like a slum clearance after the bulldozer has gone through it; but, to continue the figure, his rebuilding represents fresh insight and substantial gains, even though the reviewer finds himself 'unreconstructed' as to independent and dependent clauses. It will be interesting to see how many of these new ideas find their way into the teaching of English.

As he moves from the linguistic to the literary and cultural—if such a dichotomy is possible—the chapters reflect his preoccupation with anthropology and cultural history, particularly in the last three on 'Writing,' 'Literature,' and 'Man's Place in Nature.' These parts are so rich and suggestive that one hopes the writer will give us a second book in which such views are amplified.

In contrast with far too much linguistic writing, Hockett's work has freshness and high reader interest, with here and there a bit of humor. He is a myth-destroyer in such matters as the belief that as languages progress they become more analytic; that there are tribal speeches whose vocabulary is limited to a few hundred words; and the easy classification of languages into synthetic, agglutinative and analytic. Often he resists the temptation to enter the fray on a controversial matter, preferring rather to state simply that the problem is still unsolved.

Hockett has accomplished well his announced objective of presenting the beginning student with the accepted findings in the linguistic field. But the book will do more—it will stimulate the student to read afield and thereby add to his equipment. Despite several other works of the same category, it seems to this reviewer that Hockett's work will remain high on the list of authorities on linguistics.

ESTON E. ERICSON
Gustavus Adolphus College

Author's Comment: 'Rave reviews' are sometimes elicited by plays and musical comedies, but I have certainly never expected to see such a review of any prosaic learned work from my typewriter.

Despite my deep sense of thankfulness to Professor Ericson, and my disinclination to disagree with him, I feel obliged to inform the readers of this journal that not all responses to my *Course* have been as unqualifiedly favorable as his. I, myself, now find some serious errors in the book, perhaps particularly in the treatment of English phonology (*e.g.*, there are definitely four levels of stress, not three). The bibliography might better be described as 'germinal' than as 'exhaustive,' though even the former term is perhaps overly generous. It is my hope that in the not too distant future a revised edition can eliminate the most serious defects of the present version; but new defects will inevitably replace the old ones, since progress in the field of linguistics is today so rapid that a general text becomes obsolescent in the time it takes a publisher to transform typescript into printed book.

CHARLES F. HOCKETT
Cornell University

NORRIS, M., SPAULDING, P. J., and BRODIE, F. H., *Blindness in Children*. Chicago: Chicago University Press, 1957. Pp. 163. $3.00.

Blindness in Children has been a long time coming but its arrival introduces a novel way of talking about blind children. The book is unique since it represents a research report of a five-year longitudinal study of 259 blind preschool children in the Chicago areas. The authors are social workers and psychologists and utilize the social case work method with periodic visits and observation of the children in the family

setting. As social workers, the authors use the social case work method by which they learn every fact from every source, and about every phase of the blind child as an individual. From this body of evidence which illuminates the total child, they attempt to extract the precise problems which cause maldevelopment and maladjustment. They track down these etiological factors and construct plans to vitiate their influence. Their alternate hope is the habilitation of the blind child and his integration in a seeing world.

Habilitation is a dynamic, complicated process requiring skill, patience, time, courage, financial cooperation, and participation of many people and organizations. Especially important is the active participation of the blind child's family in their own and their children's reconstruction. The book may be construed to represent the author's declaration of facts and firm convictions: (1) that in general, blind children do not need to differ from seeing children in spite of their visual disability; (2) that through the process of habilitation and rehabilitation based on a consideration of all attending factors, the visually handicapped may be converted and the personality developed and reconstructed to function instrumentally in a seeing environment; (3) that science, medicine and education can and should help the blind child in the adjustment process; (4) that retrolental fibroplasia, 'the most common cause of blindness among children in the preschool age,' is not a manifestation of brain damage; (5) that the medical and educational management of the preschool blind child requires orientation, active participation, and adjustment of the important people in the child's environment; and (6) that the lack of 'normal' development of preschool blind children may be attributed to inadequate parental attitude and adjustment.

An analysis of the book reveals the ambitious task the authors set for themselves. In the reviewer's mind, there is some question as to whether they achieved their objectives unequivocally. The experimental design is somewhat ambiguous since it appears to be one of utilizing hindsight rather than foresight. There is a good deal of question concerning the conduct of an experiment on an informal basis unless it is an exploratory study to help the experimenter set up the design a priori to the prosecution of the actual investigation. Another deficiency is the lack of controls, which makes any finding difficult to generalize. It is also difficult to imagine how a project which is carried on an informal basis for five years is established on a formal basis without design and rigorous control proceedings. Of 259 children studied, 66 were studied intensively. Although the authors specify their criteria for the selection of the 66 children, they are not clear as to whether they used a table of random numbers for the selection process in order to eliminate bias.

The authors also report that rather than brain injury, the general cause for delayed development in the children of the study could be attributed to inadequate parental relationships. Such a pronouncement is too packed to become a generalization without further study. Another concept the authors introduced is a strong motivation to save the preschool blind child from traditional educational approach. This becomes puzzling since the authors do not specify what they consider the traditional educational approach to be. How does the traditional educational approach differ from the approved advocated method by Cutsforth and other authorities? In any individual there are three sources which make a contribution to the lack of development: (1) factors within the individual, (2) factors within the family, and (3) factors within the environment.

The experiment covers the first part of the book. The second part of the book is devoted to six case histories of children with retrolental fibroplasia. These six case histories illustrate a variety of adjustment patterns of these children. The book also includes an extensive bibliography which makes a valuable contribution in itself. The 'concept of stimulus need' permeates the entire volume.

Notwithstanding the inadequacies noted, the book nevertheless is a refreshing one and does attempt to present findings devoid of sentimentalism usually associated with attitudes concerning blind children. The book should be useful to professionals as well as to parents and the general public.

Louis M. DiCarlo
Syracuse University

Reiss, Samuel, *Language and Psychology*. New York: Philosophical Library, 1959. Pp. 299. $3.75.

Although the title is alluring to any speech scientist or therapist interested in the basic areas of words and meaning or

words and behavior and although the author in his preface promises to come to grips with the 'fundamental problem of what sort of entities words are' and what is their relationship to meaning, the allure is soon lost and the promise, in the reviewer's opinion, is not kept.

The viewpoint is excessively constricted: the contributions of information theory, statistical analysis, and semantic analysis are summarily dismissed. The outlook is strictly mentalistic.

The basic assumption of the origin of language and the accumulation of words is the onomatopoeic theory, although no reference is made to the many critical objections to this theory. In fact, there is no documentation of any sort. Important generalizations go unsupported. The following are representatives: 'The psychological process of the association of meanings construed as related to one another is thus reflected in the resemblance itself of the word-sounds'; 'The "plain" or "literal" meaning of a word, as we said, is the action or striking sound itself that is given by the word-sound'; '. . . the physicist, no less than the layman, must resort to ordinary language in order to formulate and communicate his ideas on physical reality'; 'the native vocabulary of a language is not therefore something that has come into being by any conscious invention but unconsciously as a natural expression of the biological instinct of communication within a socio-biological group.'

Although the book is replete with word lists that tend to confirm the onomatopoeic theory, such influences on language as contaminative 'slips of the tongue,' consciously coined terms in science which later become popular, phonetic distortions, and popular words derived from proper names are altogether ignored.

A few of the chapter headings will reveal the repetitions and perhaps suggest the *petitio principii* which runs throughout the book: Chapter 3 Noises and Meanings; Chapter 4 Plain and Figurative Language; Chapter 15 Words as 'Hints' to Meaning.

The book would have been more valuable had there been less over-statement of a restricted point of view, a critical use of related works, and a judicious evaluation of pertinent evidence.

WILBUR E. MOORE
Central Michigan University

Author's Comment: Dr. Moore's review of my book *Language and Psychology* reveals that he has read the book rather superficially, for its essential argument quite escapes him.

It is sufficient to cite his remark that my 'basic assumption of the origin of language . . . is the onomatopoeic theory, although no reference is made to the many critical objections of this theory.' I make no such assumption and present an altogether different concept of language origin.

The reviewer evidently missed the significance of the point, brought out in Chapter 7, 'The Imitation by the Sound of Its Meaning,' that (except for the few insignificant cases of literally imitative words) the imitative quality that appears to be felt in so-called onomatopoeic words (the word 'crash,' for example) must necessarily be of a *psychological*, not physical, character. This, however, is a most essential point that puts the concept of onomatopoeic, and of word origin, in an entirely new light.

Dr. Moore damns my outlook as 'mentalistic,' objects that 'there is no documentation of any sort' and that 'the contributions of information theory, statistical analysis, and semantic analysis, are summarily dismissed.' Indeed they are summarily dismissed, and for a very good reason. For it is precisely the thesis of the book that any mechanistic or behavioristic (*i.e.* 'antimentalistic') approach is superficial and utterly inadequate as far as concerns the comprehension either of the essential character of words (and language) or of the nature of meaning. This thesis, like the 'important unsupported generalizations' quoted, finds ample support in the discussions and in the concrete illustrations provided by the word lists, which constitute all the 'documentation' that is needed.

Naturally, as in encountering any new, hitherto unfamiliar, viewpoint—and I am quite aware of the novel, or as I would prefer it, revolutionary character of the book's viewpoint—a certain minimal 'sympathetic' effort at understanding on the reader's part is required. Where no such effort is made, he will fail to be convinced, even when the evidence stares him in the face. As the saying goes, 'You can lead a horse to the water but you can't make him drink.'

SAMUEL REISS
Cleveland, Ohio

SONDEL, BESS, *The Humanity of Words.* Cleveland: The World Publishing Company, 1958. Pp. 245. $4.00.

In *The Humanity of Words*, Dr. Sondel has attempted to summarize three important books in the area of semantics and to present her own Field Theory of Communication. She devotes a separate chapter to each of the following works: (1) C. K. Ogden and I. A. Richards, *The Meaning of Meaning*, 1923, one of the first books to offer a science of symbolism dealing with the influence of language upon thought; (2) Alfred Korzybski, *Science and Sanity*, 1933, which sets forth the basic formulations of what is now known as General Semantics; and (3) Charles Morris *Foundations of the Theory of Signs*, 1938, and *Signs, Language and Behavior*, 1946, which provide the basis for his particular semantic theory known as Semiotic.

Anyone who wishes a quick, rather superficial digest of the main points in these books may find *The Humanity of Words* of interest. It might be used as collateral reading in a Fundamentals of Speech course where there is a short unit on semantics. It could not be used for advanced or serious study. While this book is, admittedly, a primer, the presentation is so oversimplified that one misses any appreciation of the important contribution of these men, their extraordinary creative insight, and the influence of their work in the field of language theory and research. Reading Sondel's book is much like scanning somebody else's class notes when you have missed the lecture. The key points are there, but the substance and impact are lost.

In the last chapter, Dr. Sondel presents her own Field Theory of Communication. As might be expected from her background of Public Speaking, she sees communication largely in terms of speaker-audience situations, and her development of Field Theory seems to deal more with how to outline and organize a speech than with what is generally considered as communication theory. There is little here in the psychology of language, thought, perception or meaning. She emphasizes the need for finding the right 'working-title' (called the 'formator') and for developing its subpoints according to seven kinds of 'verbal patterns' (a name which she prefers to 'outline'). She discusses the relevance of this organizational planning to reading and writing and to such speaking-listening situations as conversation, conference, and public address. The appropriateness of the name Field Theory of Communication may be questioned; her own 'working-title' seems too big for the material it contains.

Dr. Sondel is a Professorial Lecturer in Communication at the University of Chicago and is Consultant in Communication to the University's Industrial Relations Center. Among her books are *Are You Telling Them?, Everyday Speech, Speak Up! A New Approach to Communication*, and *Communication: A Field Theory*.

LAURA L. LEE

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Author's Comment: A semantic analysis of Mrs. Lee's review reveals scattered informative statements which report topic headings of the five parts of *The Humanity of Words*, as indicated in the Table of Contents, and some biographical data concerning my work, as indicated in the jacket. Sandwiched between these introductory statements is a semantic morass of valuative and incitive proclamations without informative base. Nowhere is there evidence of designators to support appraisers and prescriptors. Even the novice should avoid this semantic trap.

Mrs. Lee reads with blinkers. She reads (if I, too, may be appraisive) as if she were 'scanning somebody else's class notes' without an understanding of their unifying relationships, and hence, of their meanings. Can it be possible that Mrs. Lee missed the lecture? I had no intention of capturing the genius of my sources. I moved straight away from the determinative context of Ogden and Richards to the map-territory analogy of Korzybski, and, thence, to the formators of Morris, thus to explicate the use of verbal patterns as a method by which to communicate ideas and ideals in a structured by chancy world. Yes, indeed, I prefer the word 'pattern' to 'outline'—a term to which Mrs. Lee clings nostalgically. Read the works of L. L. Whyte, of Erwin Schrödinger, of Max Wertheimer, of Floyd Allport, of Donald MacKay, of Norbert Wiener, and others too numerous to mention. Ponder over their definitions of pattern—from their various perspectives—and decide whether or not the term 'outline' is suitable to communication theory 1959. Lay that ghost.

There is 'little here in the psychology of language, thought, perception or meaning,' says Mrs. Lee, and, characteristically, drops it there. What is thinking if it is not the disposition to make verbal patterns? Perhaps Mrs. Lee will quarrel with Einstein

when he speaks of the concept as a *uniting* agency. The isolated datum is meaningless. And what is perception but a *patterned* event, a *structured* transaction between perceiver and what is perceived? Mrs. Lee saw words—'a digest of main points.' But she did not perceive how they hang together. For her, therefore, the work has little meaning. Perception, it is said, calls for both the capacity and the (psycho-physiological) willingness to entertain stimuli; rejection of stimuli, it is said, may be explained at least in part by the state of readiness of the observer.

I wrote adventurously, I know. I would not do otherwise. And the term 'field theory' is, indeed, awesome. But, as Kirk says: 'A reader should not allow himself to panic at this. Sondel likes fields because they are open and have no barriers.' Right you are, sir! And Sondel will persist in her study of the communication process as cross-organization between communicator and relevant environment. In this cyclic transaction, the verbal pattern becomes directive because its elements are both cohesive and progressive. Direction is maintained by feedforward; correction is made by feedback. Traditional methods are not adequate to purposive behavior in a contentious world; traditional methods are not receptive to the surprise-value of the many unpredictables that may shatter ignorance and illuminate perspective.

Mrs. Lee panicked but Mrs. Sondel does not regret.

Bess Sondel

University of Chicago

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